Dover Municipal Landfill Superfund Site
Second Consent Decree for RD/RA

Civil Action No. 1:92-cv-406-M

APPENDIX A

2004 Amended ROD

(Part 1 of 3)

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 1

AMENDED RECORD OF DECISION
DOVER MUNICIPAL LANDFILL
DOVER, NEW HAMPSHIRE

September 30, 2004

TABLE OF CONTENTS
DOVER MUNICIPAL LANDFILL
Amended Record of Decision
September 30, 2004

PART 1: DECLARATION FOR THE AMENDED RECORD OF DECISION

A. SITE NAME AND LOCATION

Dover Municipal Landfill.
Dover, New Hampshire.
NHD980520191
Operable Unit #1, Entire Site.

B. STATEMENT OF BASIS AND PURPOSE

This decision document presents an amendment to the selected remedial action for the Dover Municipal Landfill (the Site), in Dover, New Hampshire, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 USC § 9601 *et seq.*, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as amended, 40 CFR Part 300. The Director of the Office of Site Remediation and Restoration (OSRR) has been delegated the authority to approve this Amended Record of Decision.

This decision was based on the Administrative Record, which has been developed in accordance with Section 113 (k) of CERCLA, and which is available for review at the Dover Public Library and at the United States Environmental Protection Agency (EPA), Region 1, Office of Site Remediation and Restoration (OSRR) Records Center in Boston, Massachusetts. The Administrative Record Index (Appendix B to this Amended ROD) identifies each of the items comprising the Administrative Record upon which the selection of the remedial action is based.

The State of New Hampshire concurs with the selected remedy.

C. RATIONALE FOR AMENDMENT

In 1991 the EPA and the New Hampshire Department of Environmental Services (NHDES) chose a remedy described in a Record of Decision (ROD)(the 1991 ROD) for the Dover Municipal Landfill Superfund Site. The 1991 ROD had two components, Source Control and Management of Migration. The Source Control component consisted of capping the approximately 50-acre landfill with a RCRA C cap, installing a diversion/interceptor trench to capture contaminated leachate emanating from the landfill to prevent it from migrating into the surrounding ground water and addressing arsenic contaminated sediment in a drainage trench and drainage swale. The Management of Migration component addressed two extended ground water contaminant plumes migrating from the landfill that are contaminating a drinking water aquifer and threatening a drinking water reservoir. This component consisted of pumping and treating contaminated ground water from the portion of the aquifer migrating towards the Bellamy Reservoir (the Southern Plume) while allowing the ground water flowing towards the Cocheco River (the Eastern Plume) to naturally degrade.

The landfill cap reached 100% design but neither component of the 1991 ROD was built because, at the request of the responsible parties, a pilot study was performed to determine if an alternative, innovative cleanup approach could replace the Source Control component of the 1991 ROD. Following more than ten-years of additional study at the Site the responsible parties offered an alternative Source Control component for the 1991 ROD that would be less expensive, and would offer greater flexibility in addressing contamination at the Site. The alternative uses an air-sparging trench to act as the Source Control component to halt migration of contamination from the landfill.

The EPA and NHDES believe that the proposed air-sparging trench has the potential to be as protective as the Source Control component of the 1991 ROD and is less expensive. Most significantly, the air-sparging trench has the potential to accelerate the cleanup by decades through its flushing action rather than entombing wastes beneath an impermeable cap that requires perpetual maintenance and operation of wells to lower ground water out of the contaminant mass. Air-sparging will allow the landfill to reach clean closure at which time the aquifer will be restored to drinking water quality and re-use of the site will be allowed without further institutional controls. However, considerable uncertainty remains over the ability of the air-sparging trench to be implemented and to function as designed. Therefore, as an additional measure of protectiveness, the Source Control component of the 1991 ROD will be retained as a contingent remedy.

In addition to changing the Source Control portion of the 1991 ROD, the responsible parties also requested that EPA evaluate a change to the Management of Migration alternative for that portion of the ground water migrating towards the Bellamy Reservoir, the Southern Plume. The 1991 ROD addresses contaminated ground water in the Southern Plume through pump-and-treat. The responsible parties requested that EPA consider amending the 1991 ROD remedy to Monitored Natural Attenuation (MNA). Because present data indicates that MNA is not appropriate for the Southern Plume, active measures proposed in the 1991 ROD are retained to address this portion of the aquifer. Therefore, EPA and NHDES have elected to change only the Source Control component of the 1991 ROD and retain the 1991 Management of Migration component, with some additional assessment and monitoring requirements.

D. ASSESSMENT OF THE SITE

The response action selected in this ROD Amendment is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

E. DESCRIPTION OF THE ROD AS AMENDED

The original, 1991 ROD Source Control component at the landfill consisted of capping the wastes with a RCRA C cap and capturing leachate flowing from the landfill. This ROD Amendment changes the Source Control component and adds some assessment and monitoring requirements to the 1991 Management of Migration component. The major portions of the complete remedy, as amended, include:

- Maintain the existing vegetative cover over the entire landfill. Infiltrating water will mobilize contaminants in the landfill and convey them to an air-sparging trench at the perimeter of the landfill for treatment.

- Identify additional source areas. Areas of high contamination within and adjacent to the landfill will be located and addressed by either excavation or other *ex situ* technology, as appropriate.

- Construction and operation of air-sparging trench. The air-sparging trench will be installed in phases or segments and will follow the perimeter of the landfill. It will capture arsenic, recover volatile organic compounds, and create an environment that will biodegrade tetrahydrofuran. Where contaminant concentrations may exceed the capacity of the trench, the ground water source areas will be addressed through either direct removal or pumping and treating, as appropriate. Extracted ground water will be treated to remove metals through flocculation and organic compounds by carbon treatment.

- Sediment monitoring in Cocheco River for human health and ecological risks, followed by excavation if appropriate.

- If the air-sparging trench is not performing sufficiently to remove the contaminants flowing from the landfill, the original 1991 ROD Source Control component is the contingent remedy which requires capping the landfill with a RCRA C cap. To avoid delay in the event that the contingency is invoked, the original 100% design of the cap will be upgraded simultaneously with the design of the air-sparging trench.

- Removal of arsenic-contaminated sediment from drainage trenches and the drainage swale using cleanup criteria described in the 1991 ROD which is 50 parts per million (ppm).

- Expand on and conduct additional pre-design studies to, among other objectives, define the lateral extent, depth, and mass of the contaminated groundwater in the Southern Plume as well as the location and pumping rates of the proposed extraction wells. Pre-design studies are not to exceed one-year after the beginning of design, as determined by EPA, for the Source Control component.

- Monitored Natural Attenuation (MNA) for contaminated ground water in the Eastern Plume moving toward the Cocheco River, a class B waterway. Five years after implementation of the Source Control component EPA will assess the cleanup progress. If EPA determines that contaminant levels are not declining at an acceptable rate, an active pump and treat system will be implemented to restore ground water in the Eastern Plume.

- Additional wells will be installed to assess and extract contaminated ground water in the Southern Plume moving toward the Bellamy Reservoir, a class A drinking water source. The extracted water will be treated and discharged. The Southern Plume will be restored to drinking water quality as quickly as possible.

- Long-term monitoring of the source area, ground water beneath and surrounding the site, indoor and outdoor air, surface water in the Cocheco River, Bellamy Reservoir and their tributaries as well as wetlands in and around the Site, and sediments in the drainage swale and in the Cocheco River, Bellamy Reservoir and their tributaries.

- Indoor air monitoring for buildings near the Eastern Plume.

- Institutional controls will consist of restrictions prohibiting ground water use both on the site and where any use may affect the migration of the ground water contaminant plumes. Additional controls will be established, as appropriate, to restrict the use of the landfill surface to those activities that do not create a risk to human health or the environment or that interfere with the integrity of the remedy. In addition, a New Hampshire Groundwater Management Zone will be established and will remain in place until the cleanup is complete.

This Amended ROD will provide a comprehensive approach for this Site that addresses all current and potential future risks caused by the landfill wastes, ground water contamination, and sediment. Principal threat wastes present at the Site include materials in the landfill such as organic compounds and arsenic that migrate into aquifers surrounding the Site and volatile organic compounds in the ground water that may infiltrate existing homes overlying the contaminated aquifers. The remedial measures will prevent further flow of contaminants from the Site in ground water and will restore ground water in the surrounding aquifers to concentrations at or below the drinking water standards through natural processes and active remediation. Once cleanup levels have been attained within the landfill, ground water will have been restored to drinking water standards and the standards of clean closure will apply to the landfill.

F. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

Section 404 of the Clean Water Act and Executive Order 11990 (Protection of Wetlands) require a determination that federal actions involving dredging and filling activities or activities in wetlands have the least adverse effects on the environment compared to other alternatives and that mitigation be carried out to the extent practicable. EPA has determined that there is no practicable alternative to the selected Amended ROD remedy which would have less adverse impacts on wetlands. Each of the alternatives had some adverse impact on wetlands, either through excavation or degradation by hazardous materials. Further, these areas have already been adversely impacted by prior activities at the Site. Mitigation activities, such as erosion control, will be performed to minimize necessary impacts and the wetlands will be restored to the extent practicable.

This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduce the toxicity, mobility, or volume of materials comprising principal threats through treatment). Because this remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure (ground water and land use restrictions are necessary until cleanup levels are met), a review will be conducted within five years after initiation of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

G. AMENDED ROD DATA CERTIFICATION CHECKLIST

The following information and relevant updates are included in the Decision Summary section of the Amended ROD. Additional information can be found in the Administrative Record for this Site.

1. Chemicals of concern (COCs) and their respective concentrations.

2. Baseline risk represented by the COCs.

3. Cleanup levels established for COCs and the basis for the levels.

4. Current and reasonably anticipated future land and ground water use assumptions used in the baseline risk assessment and the ROD Amendment.

5. Potential land and ground water use that will be available at the Site as a result of the selected remedy.

6. Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected.

7. Decisive factors that led to amending the original 1991 ROD.

7. Decisive factors that led to amending the original 1991 ROD.

H. AUTHORIZING SIGNATURES

This ROD Amendment documents the selected remedy for the Dover Municipal Landfill Superfund Site, Operable Unit #1. This remedy was selected by USEPA with concurrence of the New Hampshire Department of Environmental Services.

U.S. Environmental Protection Agency

By: ______ Date: 09|30|04

Susan Studlien, Director
Office of Site Remediation and Restoration
Region 1

PART 2: THE AMENDED RECORD OF DECISION - DECISION SUMMARY

A. SITE NAME, LOCATION, DESCRIPTION, AND RATIONALE FOR AMENDMENT

SITE NAME: The Dover Municipal Landfill, Dover, New Hampshire. CERCLIS ID # NHD980520191.

SITE LOCATION: The Dover Municipal Landfill is situated in southeastern New Hampshire, Strafford County, Dover, New Hampshire. The property lies to the south of Tolend Road where it joins Glen Hill Road. Other landmarks include the Cocheco River that lies less than 1000 feet to the north and east, the Bellamy Reservoir that lies less than 2000 feet to the south, and the Calderwood Municipal Well that lies approximately ½ mile to the north. Although the landfill occupies approximately 50 acres, ground water contamination extends well beyond the landfill boundaries, north and eastward to the Cocheco River and south towards the Bellamy Reservoir. Figure 1 is a locus map of the Site provided on page 3. Public drinking water has been supplied to current area residences along Tolend and Glen Hill Road.

SITE DESCRIPTION: The landfill covers approximately 50 acres and although wastes average 20 feet in thickness, the landfill appears to be a relatively flat area. The landfill is vegetated mostly with meadow grasses; however, poplar and other pioneer tree species are established on the older sections of the landfill. The Site is surrounded by trenches that intercept near-surface leachate emanating from the wastes. The trenches convey leachate, and other runoff, to a drainage swale on the north side of the landfill and, ultimately, to the Cocheco River. The immediate area surrounding the landfill on the east, south, and west appears to be forested with mixed hardwoods, hemlock and other pines. The north side of the landfill is light, rural, residential use with a few homes along Tolend Road and Glen Hill Road. There are a total of 23 houses within a one-quarter mile radius of the Site with an estimated population of 50. All these homes are on Glen Hill Road or Tolend Road.

The landfill consists of mostly municipal waste and received unknown amounts of liquid hazardous wastes consisting of volatile organic compounds (VOCs) as well as other organic and inorganic, hazardous wastes. This has resulted in contaminated ground water underlying and flowing away from the landfill in two plumes of contaminated ground water. One plume flows to the east and discharges to the Cocheco River, the "Eastern Plume." The second plume flows to the south, towards the Bellamy Reservoir, the "Southern Plume." The Cocheco River is a class "B" waterway used for recreational purposes. The Bellamy Reservoir is a class "A" waterway that provides much of the municipal drinking water for Portsmouth, New Hampshire and many smaller communities in southeastern New Hampshire.

The Site is shown in greater detail in Figure 2 on page 4. A more complete description of the Site can be found in Section I of the Revised Focused Feasibility Study Addendum (the EPA Addendum) prepared by the EPA, issued on June 18, 2004, and in Section I of the Revised Focused Feasibility Study (the RFFS) prepared by the Executive Committee of the Group of Work Settling Defendants, Dover Municipal Landfill (the Group), dated January 30, 2004.

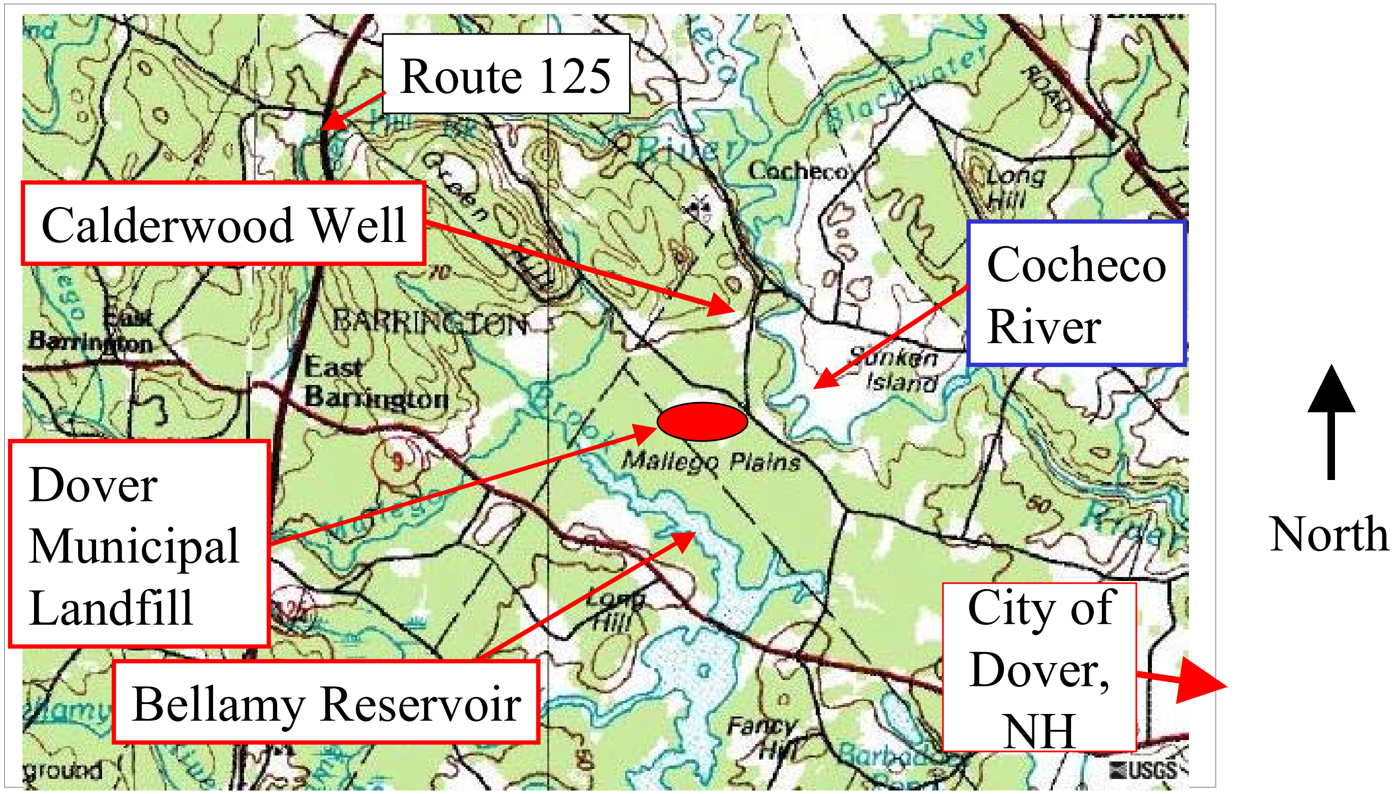

Image courtesy of the U.S. Geological Survey

0 2Km 0 1Mi

Figure 1: Locus Map of area surrounding the site.

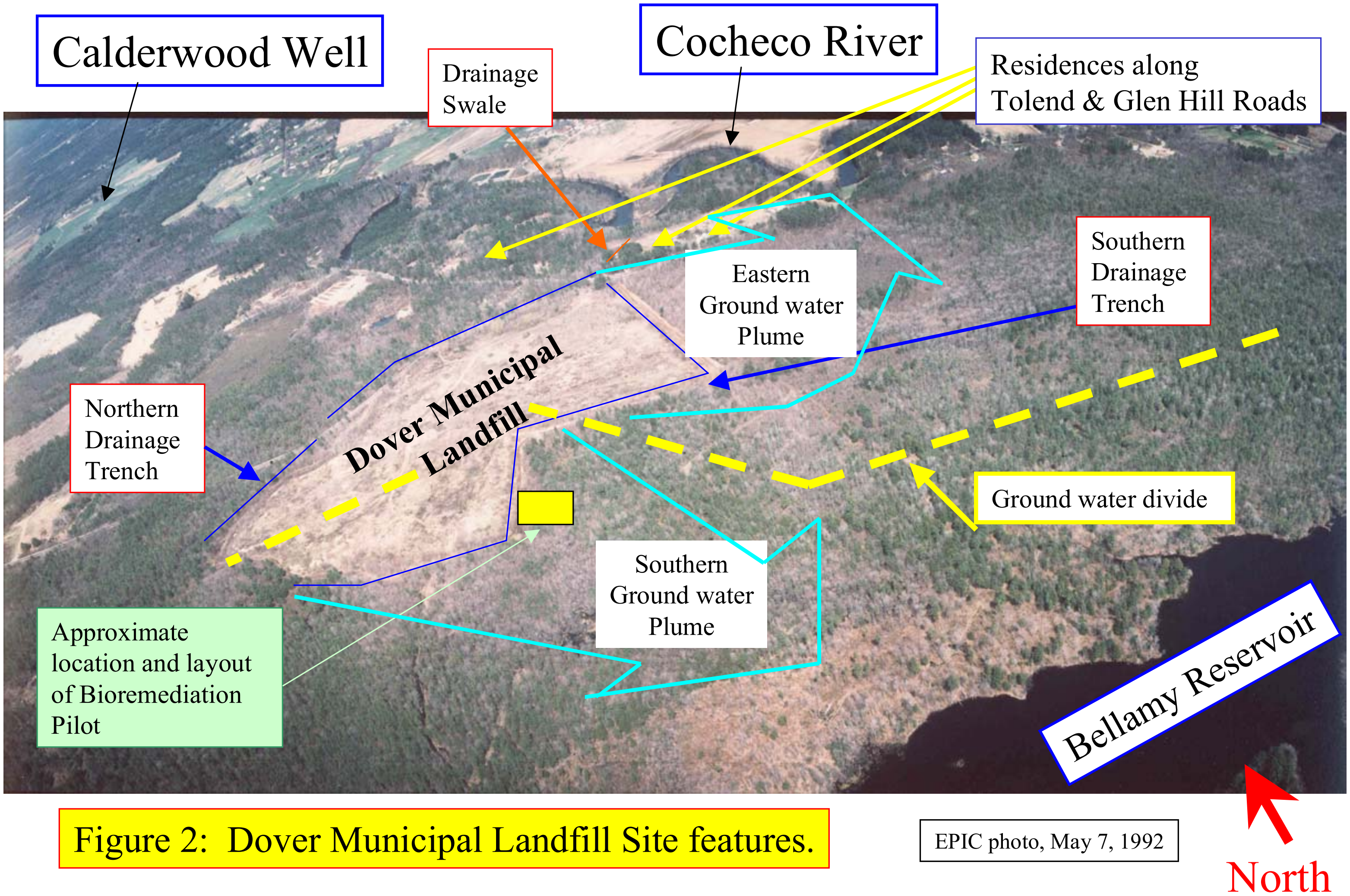

Figure 2: Dover Municipal Landfill Site features.

RATIONALE FOR AMENDMENT: On September 10, 1991 EPA, with the concurrence of NHDES, and in accordance with CERCLA issued the 1991 ROD for the Dover Municipal Landfill Site. The 1991 ROD selected the final remedial action for the Site and established target cleanup goals for sediments and ground water. Specifically, the 1991 ROD required the remediation of the landfill and ground water through Source Control and Management of Migration components, respectively. The Source Control component of the remedy would halt the migration of contaminants from the landfill into the ground water. The Management of Migration component would restore the contaminated ground water in the two plumes.

The Amended ROD uses an air-sparging trench to act as the Source Control component to halt migration of contamination from the landfill.

The decision to amend the Source Control component was based on a number of factors including the following:

With respect to hazardous wastes in the landfill:

- The Source Control component of the 1991 ROD addressed this by covering the wastes, effectively entombing them permanently. Contaminants will very slowly flow out of the wastes and into the surrounding aquifer. The cap needed to accomplish this will require perpetual maintenance.

- The Amended Source Control component will address this by allowing infiltrating water to wash the contaminants out of the landfill and move them towards an air-sparging trench that will either capture or destroy the Site contaminants. The contaminants will be captured and treated more quickly than in the 1991 ROD.

- The Amended Source Control component will potentially meet cleanup levels in ground water decades before, and at less cost than the 1991 ROD Source Control component.

- The Amended Source Control component will allow the landfill to reach clean closure with an appropriate cover in place, allowing reuse of the Site to occur more quickly.

- The Amended Source Control component offers greater flexibility in addressing Site contamination by installing an air-sparging trench that will be segmented to allow differential treatment of contaminated ground water, and, in the event of a contingent remedy, that can be used to extract contaminated ground water.

With respect to contaminants migrating from the landfill and into the surrounding aquifer:

- The Source Control component of the 1991 ROD addressed this by constructing a 25 foot deep ground water interceptor/diversion trench that would intercept contaminants. However, this trench may miss some of the deeper contaminants. These contaminants would be addressed by individual wells, but the low-dispersivity at the Site may allow deeper contaminants to escape untreated.

- The Amended Source Control component will address this by installing an air-sparging trench that will span the entire transmissive portion of the aquifer, keying into the marine clay. No contaminants will be able to go beneath the trench.

With respect to contaminated sediments in the Cocheco River:

- The Source Control component of the 1991 ROD had no provision for contaminated sediments in the Cocheco River.

- The Amended Source Control component will address this by monitoring, testing, and excavating any sediments that show a risk to human health or the environment.

For these reasons, EPA believes the Amended Source Control component to be at least, if not more protective and more cost-effective than the 1991 ROD Source Control component.

The Group also offered an alternative for the Management of Migration component. Following a review of that proposal, EPA declined to consider a change to the 1991 ROD for addressing Site ground water. Therefore, the Management of Migration components from the 1991 ROD were retained and additional assessment and monitoring requirements were added to that component. Only the Source Control component is changed in this Amended ROD. Table 1 summarizes the components of the 1991 ROD remedy and identifies the components that have changed.

Table 1: Amended Remedy Summary and Comparison

1991 ROD Remedy	Amended Remedy
Source Control	
RCRA C cap over 50-acre landfill.	✯ Existing vegetation will be maintained. The 1991 ROD 100% remedial design cap for landfill will be updated.
25-foot deep ground water interception trench will intercept contaminated ground water for treatment.	✯ Up to 100 foot deep air-sparging trench will trap and recover contaminants within the trench.
Investigations of the landfill surface to detect high concentrations and remove them.	No change. Directly address areas of contamination that the air-sparging trench will not be able to address.
Arsenic-contaminated sediment greater than 50 ppm in drainage trenches surrounding the Site and the drainage swale will be removed. Drainage trenches will be filled. Swale will remain uncovered.	No change.
Management of Migration	
Eastern ground water contaminant plume addressed through monitored natural attenuation to be assessed at 5-Year Review.	No change.
Not assessed in 1991 ROD.	✯ Arsenic contaminated sediment in Cocheco River to be removed if further sampling shows threat to human health or the environment.
Southern ground water contaminant plume addressed through pumping and treating.	No change.
Institutional controls will prevent the use of ground water for drinking water or purposes contrary to the remedy.	No change.
Long-term monitoring of ground water, surface water, and sediments will be conducted to ensure that the remedy does not pose a threat to human health or the environment.	✯ No change. Indoor air assessments will be conducted pursuant to the new EPA policy. Corrective action will be taken if necessary.
✯ Items that are changed from the 1991 ROD.	

This Amended ROD and the documents which form the basis for the Amendment are available at the following Information Repositories:

EPA Records Center
1 Congress Street, Suite 1100
Boston, MA 02114-2023
(617) 918-1453
Hours: 10am - noon and 2pm - 5pm.

New Hampshire Department of Environmental Services
29 Hazen Drive
Concord, NH
1-603-271-3644

Dover Public Library
72 Locust Street
Dover, NH
1-603-743-6050

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

1. HISTORY OF SITE ACTIVITIES

The landfill began operations in 1961 and closed in 1979. The landfill accepted household wastes as well as wastes from local industries that included liquid hazardous wastes. These liquid hazardous wastes consisted of solvents and tanning solutions that included chlorinated solvents. Although disposal practices varied over the operational life of the landfill, in the later years of operation, the liquid hazardous wastes were disposed by pouring them into surface impoundments located in the watertable on the landfill surface.[1,2] In the early 1980's ground water and surface water contamination were found in wells and surface water bodies located both on and off the landfill.

The Site was placed on the National Priorities List on September 8, 1983. Remedial Investigations begun by EPA and completed by a number of the parties that formed the *Executive Committee of the Group of Work Settling Defendants, Dover Municipal Landfill* (the Group) in the late 1980's found pervasive ground water, surface water and air contamination. The Remedial Investigations led to the 1991 ROD. The 1991 ROD selected capping of the landfill, ground water migration mitigation measures (a 25-foot deep ground water interception/diversion trench), natural attenuation of the ground water contamination in the Eastern Plume, and pump-and-treat of the ground water contamination in the Southern Plume. At around the time the 1991 ROD was signed, institutional controls in the form of local ordinances were put in place to prevent the use of ground water and to prevent disturbance of the aquifer marine clay layer. Figure 2 on page 4 shows the current, approximate location of the ground water contaminant plumes and a summary of the Site stratigraphy. After the 1991 ROD was issued, the Group agreed in a 1992 Amended Administrative Order on Consent (AOC) to further characterize the horizontal and vertical extent of the Southern Plume contamination and determine whether the contamination had reached, or would reach, the Bellamy Reservoir.

A Consent Decree to implement the provisions of the 1991 ROD was signed in 1992. However, since the Southern Plume was relatively undefined, rather than move forward with that portion of the remedy, it was agreed that the cleanup of the Southern Plume would be suspended while the Southern Plume Pre-Design Investigation (SP-PDI) was proceeding. Therefore, the Consent Decree demurred on implementing the pump-and-treat remedy in the Southern Plume. The SP-PDI was completed in 1994.

[1] GeoInsight, Revised Focused Feasibilty Study, January 30, 2004.

[2] USEPA, Environmental Monitoring Systems Laboratory, Site Analysis Dover Landfill, TS-PIC-85010, Las Vegas, NV, March 1985.

The 1994 SP-PDI found a ground water divide that split the Southern Plume into eastern and western components. The eastern component was found to ultimately discharge to the Cocheco River while the western component flowed towards the Bellamy Reservoir. The SP-PDI also found that as the plane of ground water flow deepened, the ground water flow divide moved further westward towards the Bellamy Reservoir. Modeling found that, depending on whether the landfill was capped or not capped, the ground water flow divide shifted 300 feet in a westerly direction causing most of the Southern Plume to flow eastward, away from the Bellamy and towards the Cocheco River.[3]

The 1994 SP-PDI also found that the leading edge of the Southern Plume in the most contaminated portion of the aquifer, the interbedded zone, had not significantly changed from the 1991 Remedial Investigation and was not pervasive. The SP-PDI concluded that discharge is primarily towards the Cocheco River in the interbedded layer and that the contaminated ground water plume in the interbedded aquifer of the Southern Plume would not pose a threat to the Bellamy Reservoir <u>if the landfill were capped</u>. The MODPATH modeling analysis found that even in the no-cap scenario the contaminants in the interbedded zone migrate very slowly and will have only migrated 350 feet beyond the landfill toe at the end of forty years. Also, using modest, but untested assumptions, preliminary analysis of natural attenuation found that concentrations of contaminants in the Southern Plume would be reduced below cleanup levels prior to arriving at the Bellamy Reservoir. Lastly, the installation of a cap would divert additional ground water flow away from the Bellamy and towards the Cocheco River. Based on these findings, the SP-PDI concluded that the Bellamy Reservoir would not be impacted by the Southern Plume and that groundwater extraction and treatment in the Southern Plume was not necessary.[4] EPA did not, however, accept these findings or amend the 1991 ROD to change the remedy for the Southern Plume.

In February 1995 the Group submitted a second Pre-Design Investigation report regarding the capping component of the 1991 ROD, the Source Control Pre-Design Investigation (SC-PDI), as required by the 1992 Consent Decree Scope of Work. The SC-PDI examined the consolidation of the sediments, detailed the elements of capping the landfill, described the details of installing and operating the ground water interceptor/diversion trench, characterized the wetlands, and determined a background concentration for arsenic in ground water at the Site of less than 10

[3] Pre-Design Study, Southern Plume, Dover Municipal Landfill Site, Dover, New Hampshire. Prepared by SEA Consultants Inc., Cambridge, MA, July 1994.

[4] Pre-Design Study, Southern Plume, Executive Summary, page ix.

parts per billion.[5]

A number of subsequent studies, performed independently by the Group, followed the SC-PDI and were issued in May 1996. These reports further described the hydrogeology of the Site and discussed treatability studies to address ground water contamination using *in situ* bioremediation and air stripping. The results of these studies were offered by the Group as a proposal to seek an alternate remedy to the 1991 ROD remedy for the Southern Plume.[6] EPA reviewed these documents and found several deficiencies in the proposed approaches to *in situ* bioremediation and air-stripping.[7]

The SC-PDI served as the basis of the remedial design for the cap and the ground water interceptor/diversion trench. A 100% remedial design was submitted by the Group in December 1996; however, it was not approved pending consideration of a new approach to Source Control remediation. In 1996, based on communication between the Agencies and the Group, a new, *in situ* bioremediation approach was developed for consideration as an alternative to the Source Control component of the 1991 ROD.

The Group conducted a pilot test of this new, *in situ* bioremediation approach under a 1997 Administrative Order on Consent (1997 AOC). The 1997 AOC held the approval and implementation of the 1996 remedial design of the landfill cap and the 1992 Consent Decree in abeyance until the conclusion of the Bioremediation Pilot Project. Accompanying the 1997 AOC was a Memorandum of Understanding establishing NHDES as the lead agency for oversight of the Bioremediation Pilot Project.

The Bioremediation Pilot Project began in 1997. The project sought to mineralize or immobilize Site contaminants by injecting amendments into the ground water. The Pilot Project concluded in 2001 with the NHDES and EPA determining that this alternative approach had failed to prove superior to the 1991 ROD for the Source Control component. The Pilot Project failed primarily because low values of dispersion in the aquifer prevented the homogeneous and

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[5] Pre-Design Investigation Report, Dover Municipal Landfill, Dover, New Hampshire, Prepared by Golder Associates, Inc., Manchester, New Hampshire, February 1995.

[6] Attachment A, Updated Hydrogeologic Information; Attachment B, Treatability Study Report; Attachment C, Limited Field Sparging Test Summary Report; Attachment D, Treatability Study Work Plan; Attachment E, Focused Feasibility Study; Attachment F, Field Demonstration Work Plan. GeoInsight, Londonderry, New Hampshire, May 17, 1996.

[7] Comment letter from A. F. Beliveau, EPA QA office, to EPA Project Manager Cheryl Sprague, February 13, 1996. Comment letter from Don Draper, EPA Ada Lab, to EPA Project Manager Cheryl Sprague, October 7, 1996.

predictable distribution of amendments needed to ensure the destruction or immobilization of contaminants.[8] The Agencies's analysis of the Bioremediation Pilot Project is contained in Appendix A of the EPA Addendum.

The Agencies believed, however, that the remedy proposed by the Group would be viable if the delivery of the amendments was by a continuous source, such as a porous media trench. The Group proposed using a trench that spanned the aquifer to distribute the amendments which could ensure complete mixing, the primary defect of the original Bioremediation Pilot Project. The Group then prepared a Revised Focused Feasibility Study (RFFS), completed on January 30, 2004. EPA responded to that document not by approving it, but rather by issuing EPA's Addendum on June 18, 2004.

A more detailed description of the Site history can be found in Section 1 of the EPA Addendum and the RFFS.

2. HISTORY OF CERCLA ENFORCEMENT ACTIVITIES

A number of parties formed the *Executive Committee of the Group of Work Settling Defendants, Dover Municipal Landfill* (the Group) and are primarily responsible for investigation and cleanup activities at the Site. A more detailed history of enforcement actions at the Site can be found in Section II.B. of the 1991 ROD.

C. COMMUNITY PARTICIPATION

This Amended ROD meets the criteria for community involvement specified in Sections 300.435(c)(2)(ii)(A) through (H) of the NCP.

Throughout the Site's history, community concern and involvement has varied. In 1991 public comments on EPA's Proposed Plan for Site cleanup were dominated by concerns regarding the cost of the remedy. Most citizens and officials commented that monitoring and institutional controls were sufficient for the Site. Some members of the public and the Water Department of the City of Portsmouth supported the remedy proposed at that time and expressed concern for their surrounding environment and the drinking water reservoir.[9]

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[8] Agency Response to the Draft Final Bioremediation Pilot Assessment, Dover Municipal Landfill. Comment letter from Andrew Hoffman, NHDES to Dean Peschel, City of Dover, April 23, 2002.

[9] Record of Decision, Dover Municipal Landfill, U.S. EPA, September 1991. Page 6 of the Responsiveness Summary.

Because of the low population density in the area of the Site, most participation has been by City officials for Dover and Portsmouth, New Hampshire, non-governmental organizations interested in the Cocheco River, and a few residents. Recently, one non-governmental organization, the New Hampshire TAG Force, received a TAG grant from EPA. Below is a brief chronology of recent public outreach efforts:

- In early June 2004 NHDES met at the Site with concerned parties including several local residents and officials of the Cities of Dover and Portsmouth, New Hampshire to discuss EPA's Amended Proposed Plan that was issued on June 18, 2004.

- In mid-June 2004, EPA placed a press release in the local newspaper, *The Foster Daily Democrat*, outlining EPA's intention to amend the 1991 ROD and announcing the date, time and place of a public meeting and public hearing and the availability of supporting documentation and the Amended Proposed Plan.

- Shortly after the press release, EPA sent notice of the public meeting and public hearing and a copy of the Amended Proposed Plan to parties on the mailing list. EPA also sent electronic copies of the Amended Proposed Plan and supporting documentation to City officials, representatives of the New Hampshire TAG Force, and several other interested parties.

- On June 21, 2004, EPA and NHDES held a public informational meeting in the Dover Town Hall to describe the Amended Proposed Plan and EPA's preferred remedy.

- On June 21, 2004, EPA made the administrative record available for public review at EPA's offices in Boston and at the Dover Public Library.

- From June 22nd to July 21st the Agency held a 30 day public comment period to accept written comments on the alternatives presented in the RFFS, EPA's Addendum and the Amended Proposed Plan and on any other documents previously released to the public. Upon request, the public comment period was extended to August 11, 2004.

- On July 19th the Agency held a formal public hearing to discuss the Amended Proposed Plan and to accept any oral comments. A transcript of this meeting and the Agency's response to formal oral and written comments are included in the Responsiveness Summary, which is part of this Record of Decision Amendment.

- Local residents, primarily from the Cocheco River Watershed Association, formed the New Hampshire TAG Force to monitor Site activities, and review the proposal for this Amended ROD. They applied for and have been awarded a TAG grant and have retained a TAG consultant.

Overall, the EPA has kept the community and other interested parties aware of Site activities through press releases, public meetings and informal contacts. Pursuant to Section 300.825(c) of the NCP, EPA updated the Administrative Record in June 2004 to add the documents which EPA relied on to form the basis for the decision to amend the response action for OU#1 at the Dover Site. See Appendix B for the Administrative Record Index.

D. SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

The Dover Municipal Landfill consists of a single operable unit, OU#1, consisting of Source Control and Management of Migration components. This ROD Amendment pertains only to the Source Control component of the remedy with some additional assessment and monitoring requirements for the Management of Migration component.

The Source Control component consists of controlling the source of contamination at the Site, the landfill. The approximately 50-acre landfill contains contaminated materials in both liquid and solid form. The landfill surface has a permeable, vegetated soil cover that prevents contact with the wastes. There are also two drainage trenches dug along the lateral limits of the landfill that are intended to intercept leachate flowing from the landfill. One drainage trench, the southern drainage trench, begins on the western edge of the Site, flows eastward along the southern boundary of the landfill before turning north and eventually flowing into a drainage swale north of Tolend Road. A northern drainage trench also originates on the western side of the landfill; however, flows northward before turning east and eventually discharging into the same drainage swale as the southern drainage trench. The drainage swale flows northward and discharges into the Cocheco River. Actions in the drainage trenches and drainage swale are considered to be a Source Control component.

The Management of Migration component consists of restoring contaminated ground water that is flowing in the aquifers below and surrounding the landfill. It includes contamination that is sorbed to the aquifer materials. Ground water is divided into two plumes of contamination, an Eastern Plume and a Southern Plume. The Eastern Plume has migrated such that sediments in the Cocheco River have been contaminated. Actions taken to address these sediments are considered to be a Management of Migration component.

E. DESCRIPTION OF CHANGES TO THE 1991 ROD

1. DESCRIPTION OF THE 1991 ROD REMEDY

The 1991 ROD remedy consisted of Source Control and Management of Migration components. The Source Control component of the 1991 ROD (SC-7/7A) consisted of:

- Use of on-site material from the perimeter of the landfill to recontour the existing landfill surface to achieve the necessary slope for drainage.
- Construction of a multi-layer RCRA C cap over the re-contoured landfill.
- Construction of a leachate/ground water extraction system and clean ground water diversion system provided by a landfill perimeter interceptor/diversion trench, extraction wells or a combination of the two.
- Operation of an on-site ground water/leachate treatment system with discharge to the Cocheco River (SC-7) or discharge to a POTW (SC-7A).
- Methane gas collection and passive venting.
- Construction of a surface run-on/run-off diversion system with sedimentation and detention basins.
- Limited drainage trench and drainage swale sediment removal and consolidation under the landfill cap.
- Institutional controls to limit Site access and Site use.
- Environmental monitoring.

Further details of the Source Control component are available beginning on page 51 of the 1991 ROD.

The 1991 ROD Management of Migration components (MM-2 and MM-4) included the following elements:

- The use of institutional controls to prohibit the use of ground water and prohibit disturbance of the marine clay layer between the upper and lower aquifers at the

Site (MM-2 and MM-4).

- Implementation of a long-term ground water sampling/monitoring program (MM-2 and MM-4).

- Pre-design studies which include the installation of additional monitoring wells to further define the lateral extent, depth and mass of the contaminated ground water (MM-4).

- One or more pump tests to determine the ability and rate that contaminated ground water can be extracted from the aquifer (MM-4).

- Use of natural attenuation processes to attain ground water cleanup levels in the Eastern Plume (MM-2).

- Installation of several off-site ground water extraction wells in the Southern Plume, connection to an on-site treatment system, extraction and treatment of the ground water and recharge of the treated ground water to the wetlands or discharge to the Cocheco River (MM-4).

Details of the Management of Migration component begin on page 57 of the 1991 ROD.

Cleanup levels were established for contaminated sediments in the drainage trenches that surround the Site and for contaminated groundwater based on ARARs and health-based calculations. The ground water cleanup levels established in the 1991 ROD are shown in Table 11 on page 73.

2. COMPONENTS OF 1991 ROD REMEDY COMPLETED TO DATE

With respect to the Source Control component the City of Dover enacted an ordinance that created a hazardous waste district that prohibits development and use of ground water in the area of the landfill until the cleanup is completed. The Town of Madbury similarly enacted an ordinance creating an overlay district that prohibits the use of ground water. In addition, the capping component of the remedy reached 100% design in 1996 and arsenic-contaminated sediments in the drainage trench and drainage swale were removed in 1997. A ground water / surface water sampling program has been in place for more than ten years and limited pre-design activities in the Southern Plume have been conducted.

3. CHANGES TO THE 1991 ROD REMEDY

This Amendment changes only the Source Control component of the 1991 ROD remedy. In addition, the 1991 Management of Migration component is now expanded to include the assessment of contaminated sediments in the Cocheco River and excavation if necessary. Also, air monitoring of buildings near the Eastern Plume will occur with remedial measures taken if it is shown that vapors from contaminated ground water cause a human health risk.

This ROD Amendment elects to address the source of contamination, the landfill, by leaving the landfill uncapped and installing an air-sparging trench that surrounds the waste area. This replaces the original Source Control component of a RCRA C landfill cap and ground water diversion/interceptor trench. EPA recognizes that the air-sparging trench is innovative and will pose technical challenges; however, the remedy provides for engineering alternatives to address these challenges as well as the contingency that the Source Control component will revert back to the original RCRA C capping requirement in the event that the innovative technology is unsuccessful. To that end, the ROD Amendment requires that the original 100% cap design be updated simultaneously with the design of the air-sparging trench. To better define the technical challenges, the air-sparging trench will be installed in phases to ensure it performs as expected.

To summarize the change to the Source Control component:

- The landfill remains uncapped to allow infiltrating rainwater to travel through the landfill wastes, absorbing contaminants, and then be conveyed to the air-sparging trench.

- Areas of high contamination within and adjacent to the landfill will be located and addressed by either excavation or other *ex situ* technology, as appropriate.

- An air-sparging trench, approximately 3000 feet long by up to 100 feet deep by 3 feet thick will capture arsenic by precipitation, volatile organic compounds (VOCs) by volatization, and aerobically degrade tetrahydrofuran (THF).

- Arsenic precipitate will be removed by excavation at the conclusion of the remedy or if fouling occurs. Other methods of removal may be investigated and used if appropriate.

- VOCs and other volatile gases will be recovered for treatment if emissions exceed regulatory levels and discharged to the atmosphere.

- Down-gradient monitoring will ensure that ground water exiting the air-sparging trench meets cleanup levels and that the remedy is performing as expected.

If it is found during the phased construction or later, that the air-sparging trench is not performing sufficiently to remove the contaminants flowing from the landfill, the Source Control component of the 1991 ROD, SC-7/7A (i.e., capping the landfill), will be the contingency remedy that will be implemented at the Site.

There are also two changes to the Management of Migration component of the 1991 ROD:

1. Sediment in the Cocheco River will be monitored to ensure concentrations of arsenic do not pose a risk to human health and a Tier 2 ecological risk assessment will be performed, followed by a Tier 3 evaluation, if warranted, and removal if necessary.

2. Indoor air vapors will be evaluated in buildings near the Eastern Plume. Corrective action will be taken if necessary.

Also of note is the use of EPA's Monitored Natural Attenuation protocol for the Eastern Plume, the application of EPA's Indoor Air Evaluation Protocol, and the revised arsenic MCL of 10 ppb that will apply to Site ground water.

F. SUMMARY OF SITE CONDITIONS AND CONTAMINATION

Section 1 of the EPA Addendum and Revised Focused Feasibility Study contain a more detailed overview of the previous investigations conducted at the Site. The significant findings of those investigations are summarized below.

1. GENERAL SURFICIAL CHARACTERISTICS

The Site is situated in an area with a low residential density. Figure 2, on page 4, shows that only a few houses line Tolend Road and Glen Hill Road where they run along the Cocheco River. There are a total of 23 houses within a one-quarter mile radius of the Site with an estimated population of 50. All these homes are on Glen Hill Road or Tolend Road. Several of the homes appear to overlie the Eastern Plume. All 23 homes, formerly served by private ground water wells, have been supplied with municipal water since 1981.

The landfill footprint covers approximately 50 acres. The original area of the landfill consisted of woodlands and wetlands that were filled during the operation of the landfill. Perimeter drainage trenches were dug along the landfill boundary during closure activities in 1979 to intercept the flow of leachate from the landfill. Although the perimeter drainage trenches drain to the drainage swale and eventually the Cocheco River, the wetlands surrounding the southern portion of the Site drain to the Bellamy Reservoir. The wetlands to the north of the landfill drain to the northern drainage trench and the Cocheco River. The floodplains of the Cocheco River and the Bellamy Reservoir do not include the landfill.

The landfill surface appears to be a large meadow, covered with grasses and low shrubs such as sumac. In older sections of the landfill, poplar and birch trees have grown. The only structures on top of the landfill consist of a small building approximately 20 by 20 feet that housed portions of the bioremediation pilot project that operated from 1997 to 2001. There are no areas of archaeological or historical importance.

2. CONTAMINATION CHARACTERISTICS

Soils, sediments, air, surface water and ground water were sampled during the remedial investigation performed prior to the 1991 ROD. Subsequent to the 1991 ROD, and based on the previous sampling results, sampling efforts focused on ground water and were later expanded to sediments in the Cocheco River. In ground water, the principal contaminants are VOCs and arsenic. Ground water has been sampled at least twice per year since 1991. In sediment, arsenic is the principal contaminant.

Site conditions have generally remained constant since EPA issued the 1991 ROD with some increasing concentrations of contaminants in the Southern Plume. The contaminated media include the wastes in the landfill, ground water below and surrounding the landfill, and sediments in water bodies that receive contaminated ground water. Below is a discussion of each of the areas of concern at the Site describing the conditions and contamination.

The Landfill

The geology beneath the landfill consists of 100 feet of sedimentary deposits on top of bedrock. Ground water flow from the landfill appears to be confined to the upper forty to fifty feet of those sedimentary deposits. Summarizing the surficial topography, the landfill is approximately twenty-feet thick; however, near Tolend Road the landfill has little topographic expression. The southern edge of the landfill surface falls rapidly ten to twenty feet to an adjacent woodland and wetland. In this area it is apparent that much of the former ground surface beneath the landfill was either wetland or low-lying forested area.

The underlying geology at the Site is comprised of glacio-fluvial deposits. A chronological record of the geology would begin with the bedrock surface, the deepest portion of the described geology, which was lain bare by the glaciers 10,000 years ago. When the glaciers retreated, they left behind outwash deposits. Because of the great weight of the glaciers, the ground surface was depressed below sea level allowing the deposition of a marine clay layer on top of the initial glacial deposits. This was followed by the deposition of additional glacial outwash deposits on top of the marine clay. The original, detailed cross-sections of the Site geology are in the EPA Addendum and in the 1988 Remedial Investigation as Figures 5-6, 5-7 and 5-8.[10]

Although the landfill is covered with a thin veneer of sand and organic matter, contaminants are mobilized by rainwater that infiltrates the landfill and then enters the ground water. Contaminants are then conveyed from the landfill by leachate, contaminating ground water, that then migrates beyond the Site either into the drainage trenches that surround the landfill or into the aquifers that underlie the Site. Contaminated ground water migrating in the aquifers may either discharge to surface water or be extracted by a well.

Contamination in the landfill consists of VOCs such as trichloroethylene (TCE), tetrachloroethylene (PCE), *cis*-1,2 dichloroethylene (1,2 DCE) and vinyl chloride; hydrocarbon compounds present at the Site include benzene and toluene; other organic compounds at the Site include tetrahydrofuran (THF) and ketones. The landfill appears to contain at least two known source areas. The first area is in the northern portion of the Site where ground water with high concentrations of VOCs discharges to the northern drainage trench when the local water table is high. The second area is in the southwestern portion of the Site and consists of high concentrations of THF. Table 2, beginning on page 23, describes the general contaminant concentrations and location in the ground water beneath the landfill and in the surrounding aquifer.

Ground Water

As previously noted, the Site is situated on a ground water divide. The northern and eastern portions of the Site drain to the east and the Cocheco River (the Eastern Plume). The western and southern portions of the Site drain to the south and the Bellamy Reservoir (the Southern Plume). The RFFS used MODFLOW-96 to assess conditions at the site in conjunction with solute transport models Version 2 of the Reactive Transport Model in 3-Dimensions (RT3D) and Version 3.5 of the Modular Three-Dimensional Transport Model (MT3D). The model used Site-specific information and assumptions listed in Appendix N of the RFFS.

Because the ground water gradients are fairly flat to the south, ground water flowing towards the Bellamy travels more slowly than that to the east and the Cocheco River. Contaminant flow in each of the respective aquifers is also restrained by retardation. Inside the landfill, ground water

[10] *Remedial Investigation, Dover Municipal Landfill, Dover, New Hampshire, Volume II, Tables and Figures.* Prepared for: New Hampshire Department of Environmental Services, Waste Management Division. Prepared by: Goldberg-Zoino & Associates, Inc. and Wehran Engineers. November 1988.

flow is very slow due to the low hydraulic gradient. Contaminants in the Southern Plume travel quite slowly and have travel times of twenty to sixty years to the Bellamy Reservoir. However, in the Eastern Plume, where the gradients are steeper, contaminants take less than ten years to travel from the edge of the landfill to the Cocheco River.[11] Figure 2 on page 4 shows the location of the ground water divide and Eastern and Southern Plumes. The general concentrations in the Eastern and Southern Plumes are shown on Figure 3 on page 28. Ground water flow and contamination is discussed in greater detail in Section 1 of the RFFS and in the EPA Addendum.

Ground water in the area underlying the landfill is labeled as GB, a background aquifer. The landfill is located in the Well Head Protection Area for the Calderwood Well as designated by NHDES.[12] The policy of the State of New Hampshire is that all ground waters are potential drinking water aquifers. Use of the ground water surrounding the landfill is subject to municipal ordinances prohibiting the installation of wells for domestic uses.[13]

Ground water - The Southern Plume

Contaminants in the Southern Plume consist of benzene, vinyl chloride, 1,2 DCE, arsenic and THF, with concentrations of arsenic increasing at the southern toe of the landfill, indicating worsening conditions. Benzene, vinyl chloride, THF and arsenic levels are above the Safe Drinking Water Act MCLs in well SB-B2, located approximately halfway between the toe of the landfill and Bellamy Reservoir - a Class “A” drinking water body. THF exceeds the interim cleanup level (ICL) established in the 1991 ROD and has increased steadily in concentration in well SB-B2 since that time. The landfill lies partially within the Reservoir’s watershed. Rising concentrations of these contaminants indicate that a significant potential exists for the discharge of contaminated ground water into the Bellamy Reservoir. This Reservoir serves much of southeastern New Hampshire’s drinking water needs. The City of Portsmouth draws 60% of its drinking water from this Reservoir. The City of Dover draws 43% of its drinking water from wells in the Bellamy Reservoir watershed.[14] Within the Reservoir’s watershed there are also many municipal drinking water wells that draw from it through induced recharge. The Bellamy Reservoir is discussed further in Appendix B of the EPA Addendum. Contaminant concentrations

[11] *Revised Focused Feasibility Study, Dover Landfill*, Appendix N, Attachment H. GeoInsight, January 30, 2004.

[12] Dover Source Water Protection Areas, NHDES, Scale 1:36000 & centered on Calderwood Well, map prepared January 21, 2004.

[13] RFFS, Appendix A, January 30, 2004.

[14] Quantifying the Bellamy River Watershed Hydrologic Budget, prepared for the Town of Madbury by Thomas Fargo, C.G., January 2002.

in the Southern Plume are summarized in Table 2 beginning on page 23 and on Figure 3 on page 28.

Ground water - The Eastern Plume

Contaminants in the Eastern Plume consist primarily of arsenic, benzene and vinyl chloride with minor amounts of TCE, PCE, and THF. While the landfill source has remained unaddressed since the 1991 ROD, there has been no discernable decreasing trend for most of these contaminants, particularly arsenic. The Eastern Plume continues to discharge to the Cocheco River which is a Class "B" water body. The Cocheco River is used for recreation, primarily fishing and boating, it flows through the City of Dover and discharges into Great Bay approximately 7 miles downstream. The Cocheco River is discussed further in Section 2 of the EPA Addendum.

The Calderwood Well lies approximately 1/2 mile north of the landfill. The area of ground water contribution to the Well extends southward to, and beneath, the landfill.[15] However, the Calderwood Well is insulated from the Site by virtue of the geology in that a layer of impervious marine clay, approximately 20 to 40 feet thick, is found between ground water influenced by the landfill and ground water used by the well. Approximately 24% of the City of Dover's drinking water comes from this well.[16]

Contaminant concentrations in the Eastern Plume are summarized in Table 2 beginning on page 23 and on Figure 3 on page 28. The original, detailed cross-sections of the Site geology are in the EPA Addendum and in the 1988 Remedial Investigation as Figures 5-6, 5-7, and 5-8.

[15] Dover Source Water Protection Areas, NHDES, Scale 1:36000 & centered on Calderwood Well, map prepared January 21, 2004.

[16] William Boulanger, Utilities Supervisor, City of Dover Water Supply, personal communication January 6, 2004.

Table 2: The Characteristics of Aquifers at Dover Municipal Landfill
Stratigraphic units are arranged from upper-most to lowest

Stratigraphic Unit	Plume	Contaminant concentrations and characteristics in 2002: Contaminant (ICL)	Average Concentration (ppb)* ± 1 std. dev.	Maximum Concentration (ppb)*	#wells >ICL** / #wells	Stratigraphic thickness (feet above mean sea level) and general description
Landfill	Only a few wells inside the landfill; however, all show contaminants with constant concentrations above the ICLs and few downward trends.					165 - 145 feet above mean sea level (msl). Waste appears very flat.
Upper Sand	Eastern	Benzene (5) Vinyl chloride (2) THF (154) Arsenic (50)	26 ± 28 4 ± 7 65 ± 130 209 ± 82	68 14 260 320	4/4 2/4 1/4 4/4	145 - 135 msl. Sand pinches out to the north and thickens to the east. Sand unit is approximately 30 to 40 feet thick at the Cocheco River.
	Southern	Benzene Vinyl chloride THF Arsenic	24 ± 15 7 ± 11 399 ± 414 117 ± 131	44 25 970 327	4/5 2/5 3/5 3/5	Dips to the south; however, thickness remains about 15 to 20 feet. The upper sand directly contacts the Bellamy Reservoir. The water level in the Reservoir is approximately 135 feet msl.
Upper-Upper Interbedded	Eastern	Benzene Vinyl chloride THF Arsenic	49 ± 18 11 ± 9 88 ± 179 207 ± 233	79 26 540 634	9/9 8/9 2/9 6/9	135 to 115 feet msl under the landfill, pinches out to the north. Dips and thickens to the east. Ground water from the interbedded zone flows into the Cocheco River which is at an elevation of approximately 110 feet msl.
	Southern	Benzene Vinyl chloride THF Arsenic	30 ± 12 1 ± 1 933 ± 827 174 ± 147	44 4 2400 376	7/7 1/7 6/7 5/7	Thickens to the south, lies about 20 feet beneath the surface of the Bellamy Reservoir and discharges through the upper sand into the Reservoir.

Table 2: The Characteristics of Aquifers at Dover Municipal Landfill
Stratigraphic units are arranged from upper-most to lowest

Stratigraphic Unit	Plume	Contaminant concentrations and characteristics in 2002				Stratigraphic thickness (feet above mean sea level) and general description
		Contaminant (ICL)	Average Concentration (ppb)* ± 1 std. dev.	Maximum Concentration (ppb)*	#wells >ICL** / #wells	
Lower-Upper Interbedded	Eastern	Migration limited by vertical conductivity, low amounts of contamination if any. Arsenic is the only contaminant in concentrations over the ICL of 50. 3 wells out of 5 are over 50 ppb.				The thickness of this unit was included in the upper interbedded strata described above. The reason why no differentiation is that the boundary is very gradational and therefore separating the two units is arbitrary in some locations.
	Southern	Same as Eastern Plume; however 3 of 4 wells are over 50 ppb.				
Marine Clay	115 to 100 feet above msl beneath the landfill. The marine clay strata dips to the southeast where it lies more than 100 feet below the surface. The marine clay actually surfaces to the north of the landfill. Although few wells monitor this interval, this unit is considered to be uncontaminated as it is impermeable to ground water and contaminant flow. Therefore, it is assumed that this unit insulates the underlying aquifers.					
Clay & Silt	100 to 95 feet above msl beneath the landfill.					
Sand & Gravel	95 to 90 feet above msl beneath the landfill. This unit thickens considerable to the north and ultimately is the main aquifer that the Calderwood well draws from ½ mile to the north of the Site. Based on monitoring at the Calderwood well, this aquifer is not contaminated.					
Bedrock	Surface is 90 feet above msl.					

* This data is taken from the May 2002 sampling round.

** The Interim Clean up Level (ICL) is used in this column to indicate the number of wells contaminated above the ICL against the number monitored. For instance, in the first case, the Eastern Plume has benzene that has an average concentration of 26 ppb and a standard deviation of 28, indicating a wide spread of data. The maximum concentration of benzene in the Eastern Plume is 68 ppb. The next column, “>ICL/#wells,” is listed as “4/4," which means that of the four wells monitored in the Eastern Plume, all four exceeded the ICL for benzene of 5 ppb.

*** Note that the ICL for arsenic used in this table (50 ppb) is from the 1991 ROD. The arsenic ICL will be changed to 10 ppb as a part of this ROD Amendment.

Air

Indoor air in houses along Tolend Road, which are located directly above the Eastern Plume, may be impacted by VOCs in this ground water plume. Past monitoring has indicated that no indoor air risk was present. However, EPA has issued new guidance containing new risk assessment methodology regarding indoor air which requires that the Site be re-evaluated.

Surface Water and Sediments

The primary receptors of Site contaminants are the surface water bodies surrounding the landfill shown on Figures 1 and 2. Surface water at the Site may be divided into two watersheds, the Cocheco River and Bellamy Reservoir watersheds. The Cocheco River watershed includes the drainage trenches that lie on the perimeter of the landfill, the drainage swale that the drainage trenches flow to, and the Cocheco River. The Bellamy Reservoir watershed includes the wetlands that lie south of the landfill and flow gradually to the Bellamy Reservoir. Surface water is not impacted by Site contaminants in either watershed. No violation of Surface Water Quality Criteria (SWQC) for any VOC, other organic contaminant, or arsenic was found. Sediments in the Cocheco River watershed are contaminated with arsenic. Sediments in the Bellamy Reservoir watershed do not appear to be contaminated.

Surface Water and Sediments - Cocheco River Watershed

Two drainage trenches encircle the landfill to intercept leachate emanating from the landfill (Figure 2 on page 4). On the northwest side of the landfill is the northern drainage trench, a small, shallow ditch that flows first northward, is piped under Tolend Road, and then flows eastward to discharge to the drainage swale and ultimately the Cocheco River. The northern drainage trench is an intermittent stream, flowing during the spring and runoff events. The southern drainage trench originates on the southwest side of the landfill, flows along the southern and eastern perimeter of the landfill and is piped under Tolend Road. The southern drainage trench has a larger flow than the northern drainage trench and contains flow at all times of the year except during extended dry periods. Sediment in the southern drainage trench is orange-red and contains primarily iron with arsenic. The southern drainage trench flows eastward and then north before discharging to the drainage swale.

The drainage swale, also shown on Figure 2, combines the flow of the northern drainage trench with that from the southern drainage trench. The drainage swale, lying north of the landfill and Tolend Road, quickly drops 15 feet, picks up the flow of the northern and southern drainage trenches, and then drops 40 feet over a distance of 400 feet to the Cocheco River in a narrow valley. There is also evidence that contaminated ground water discharges directly to the drainage swale.

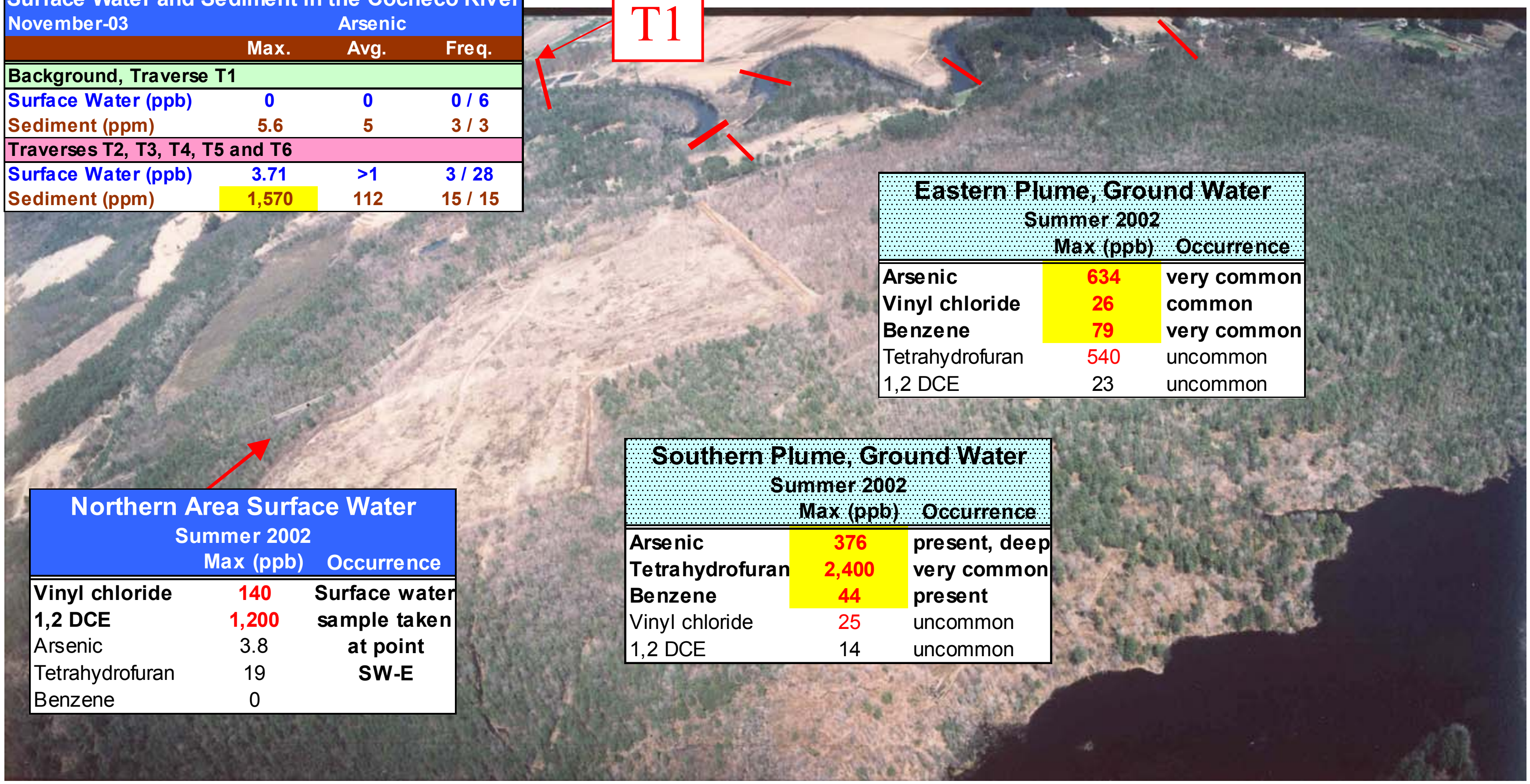
The Cocheco River receives sediment from the swale and ground water from the landfill. Ground water has arsenic concentrations that exceed the SWQC of 340 ppb (acute) and 150 ppb (chronic); however, the ground water discharges into the surface waters of the drainage trench, swale, and Cocheco River in concentrations well below the SWQC acute and chronic concentrations. This occurs because iron is also present in the ground water. The iron combines with oxygen upon discharge to these surface water bodies to form a solid residue that quickly binds the arsenic as well. Therefore, arsenic is contained in the sediments and not present above natural, background concentrations in the surface water. The sediments accumulate in the River bottom at concentrations ranging from 3 to 1500 parts per million (ppm) of arsenic.

Sediment was sampled in the drainage trenches and drainage swale for the 1991 ROD and again beginning in 2000. Sediments were sampled in six transects across the Cocheco River in 2002, with each transect consisting of three sampling stations. The sampling stations were on the bank adjacent to the Site, at mid-stream in the river, and on the far bank of the river. The results of this sampling indicated that there are a few locations of high arsenic concentration. These locations are near where the drainage swale flows into the Cocheco River and along the Cocheco River, in a linear area approximately 50 feet long, where ground water discharges to the river. The areas of high arsenic concentration coincide with high iron concentration and therefore are easily spotted as areas of red-stained sediment. The general concentrations of arsenic-contaminated sediments are shown on Figure 3 on page 28 and more particularly on Table 5 on page 36.

<u>Surface Water and Sediments - Bellamy Reservoir</u>

Surface water in the Bellamy Reservoir watershed was sampled in December 2003. Neither sample contained any VOCs or arsenic above detection limits. No sediments were sampled; however, no areas of orange-red staining were noted that indicated contaminated sediments. A large forested wetland area lies between the landfill and the Reservoir. Ground water sampling in the upper-sand, indicative of conditions in surface water in the wetland areas, does not indicate any contamination. Contaminated ground water in the Southern Plume lies approximately 20 to 40 feet beneath the land surface and is slowly flowing towards the Bellamy Reservoir without impacting intervening wetlands or streams.

Figure 3: Generalized depiction of contamination at the Dover Municipal Landfill. The maximum concentration of contaminants in ground water, surface water, and sediments. The sediment and surface water concentrations in the Cocheco River are listed beginning at transect T1. Subsequent transects, T2 to T6 proceed to the right (eastward) from T1. More information is contained in Section 2 of the EPA Addendum.



Surface Water and Sediment in the Cocheco River

November-03	Arsenic		
	Max.	Avg.	Freq.
Background, Traverse T1			
Surface Water (ppb)	0	0	0 / 6
Sediment (ppm)	5.6	5	3 / 3
Traverses T2, T3, T4, T5 and T6			
Surface Water (ppb)	3.71	>1	3 / 28
Sediment (ppm)	1,570	112	15 / 15

Eastern Plume, Ground Water
Summer 2002

	Max (ppb)	Occurrence
Arsenic	634	**very common**
Vinyl chloride	26	**common**
Benzene	79	**very common**
Tetrahydrofuran	540	uncommon
1,2 DCE	23	uncommon

Northern Area Surface Water
Summer 2002

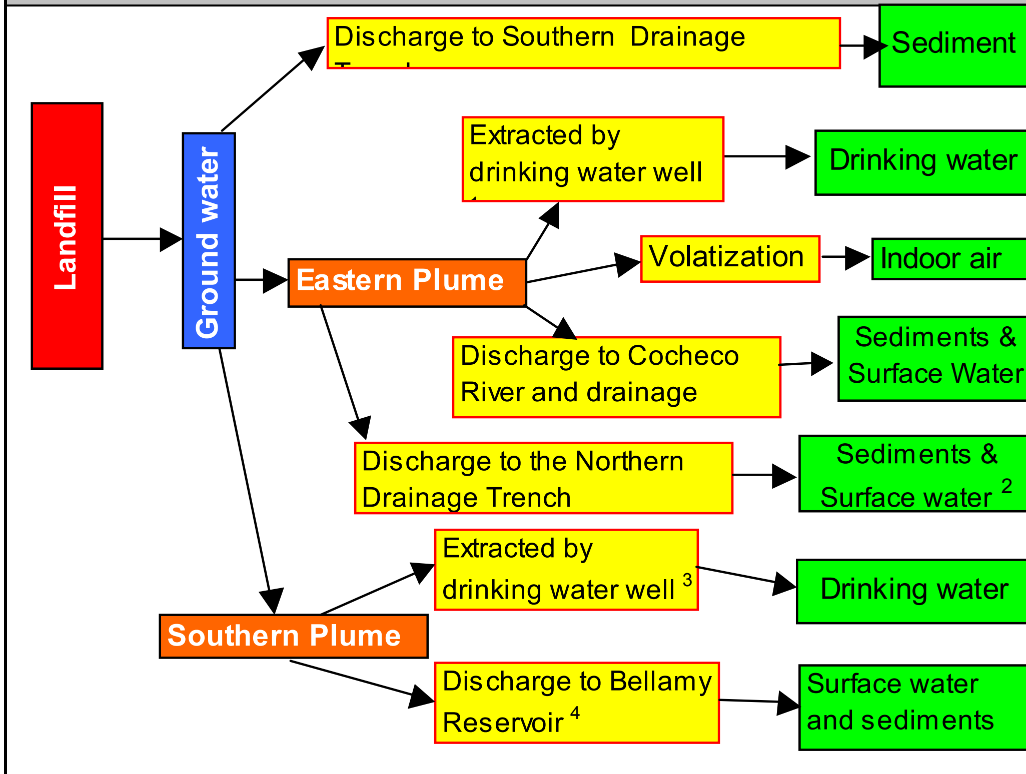
	Max (ppb)	Occurrence
Vinyl chloride	140	**Surface water**
1,2 DCE	1,200	**sample taken**
Arsenic	3.8	**at point**
Tetrahydrofuran	19	**SW-E**
Benzene	0	

Southern Plume, Ground Water
Summer 2002

	Max (ppb)	Occurrence
Arsenic	376	**present, deep**
Tetrahydrofuran	2,400	**very common**
Benzene	44	**present**
Vinyl chloride	25	uncommon
1,2 DCE	14	uncommon

Table 3 provides a Conceptual Site Model (the "CSM") for the Dover Municipal Landfill that summarizes sources, release mechanisms, pathways and receptors. The CSM is a linear depiction of Site conditions that illustrates what is known about human and environmental exposure through contaminant release and migration to potential receptors. Table 3 shows that contamination emanates from the landfill and is conveyed outward by ground water forming the Eastern Plume and the Southern Plume. There are two minor pathways shown as well, containing leachate that contaminates the sediment in the perimeter drainage trench and at least two known source areas.

TABLE 3: CONCEPTUAL SITE MODEL - DOVER MUNICIPAL LANDFILL



	RECEPTOR			
	HUMAN		BIOTA	
Exposure Route	Area Residents	Site Trespass	Terrestrial	Aquatic
Ingestion		CURRENT	CURRENT	
Dermal contact		CURRENT	CURRENT	
Ingestion	FUTURE			
Dermal contact	FUTURE			
Inhalation	CURRENT			
Ingestion	CURRENT	CURRENT	CURRENT	CURRENT
Dermal contact	CURRENT	CURRENT	CURRENT	CURRENT
Ingestion		CURRENT	CURRENT	CURRENT
Dermal contact		CURRENT	CURRENT	CURRENT
Ingestion	FUTURE			
Dermal contact	FUTURE			
Ingestion	FUTURE		FUTURE	FUTURE
Dermal contact	FUTURE		FUTURE	FUTURE

Footnotes:
#1 and 3 - Public drinking water supply has been in place since 1983. No ground water uses are allowed by municipal restriction.
#2 - Surface water concentrations do not pose a risk; however, indicate the presence of discrete areas of ground water contamination.
#4 - Contaminated ground water is not currently discharging to the Bellamy Reservoir.

Key: Primary Source | Secondary Source | Release Mechanism | Pathway

Ground water is the means by which contaminants are conveyed from the site. No other transport pathway is known.

3. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

The area surrounding the Site is sparsely populated residential use. The only residences are along the northeastern side of Tolend Road, overlooking the Cocheco River. The land to the east, south, west and north of the Site consists of hemlock forest with several wetland areas draining away from the landfill. The Bellamy Reservoir lies to the south of the landfill and much of the watershed area either contributes to the Bellamy Reservoir, a Class-A drinking water supply that serves much of southeastern New Hampshire, or is within a well-head protection area for the Calderwood Well that lies ½ mile to the north of the landfill. Much of the land surrounding the landfill is owned by the City of Dover. Activities on top the landfill are restricted by fences and signs posted along Tolend Road.

Current use of the Site and area ground water is restricted by local ordinances which prevent development and the use of ground water while remedial activities are ongoing until the cleanup is completed. Once cleanup is complete, the landfill itself will be covered with an appropriate cap. In the past the City of Dover has expressed an interest in using the landfill surface for recreational facilities or a golf course. Recently there has been some discussion between the City and the State concerning reuse of the landfill as a disposal area. Future development will be limited by the presence of a cap and its location in a well head protection area and proximity to nearby wetlands.

G. SUMMARY OF SITE RISKS

The human health risk assessment was first performed for the 1991 ROD and updated in the 2004 RFFS. See Section 8 of Volume I (a separate document) of the 1989 Remedial Investigation, Section 2.2.2 of the 1991 Feasibility Study,[17] and Section 2 of the 2004 RFFS. A limited ecological risk assessment was performed in 2002 for the RFFS. A summary of those aspects of the human health risk assessment which support the need for remedial action is discussed below followed by a summary of the environmental risk assessment.

1. HUMAN HEALTH RISK ASSESSMENT

The human health risk assessment followed a four step process: 1) hazard identification, which identified those hazardous substances that, given the specifics of the Site, were of significant concern; 2) exposure assessment, which identified actual or potential exposure pathways, characterized the potentially exposed populations, and determined the extent of possible exposure; 3) toxicity assessment, which considered the types and magnitude of adverse health effects associated with exposure to hazardous substances, and 4) risk characterization and uncertainty analysis, which integrated the three earlier steps to summarize the potential and actual risks posed by hazardous substances at the Site, including carcinogenic and non-carcinogenic risks and a discussion of the uncertainty in the risk estimates.

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[17] Dover Municipal Landfill Feasibility Study, HMM Associates, February 28, 1991.

The 1991 ROD identified a future risk to human health associated with drinking ground water contaminated with arsenic and to a much lesser extent, vinyl chloride. Current exposure to ground water was not a complete pathway in that all property owners are provided with public water. Contact with landfill soil was evaluated but also found to be an incomplete pathway since a soil cover is in place on the landfill and access is partially prevented by fencing. The soil cover prevents only dermal contact with contaminants in the soil but continues to allow precipitation to leach contaminants into the underlying ground water. Exposures to sediment in the Cocheco River and swale were evaluated and found to be within an acceptable risk range for human health via ingestion and dermal absorption, although the risk was borderline (8×10^{-5}). Exposure to surface water in the Cocheco River, Bellamy Reservoir and surrounding waters were within EPA's risk range and did not pose an unacceptable risk. Outdoor air emissions at the landfill were also within normal limits. Indoor air in buildings in areas of the Eastern Plume were previously evaluated using criteria supplied by NHDES and found not to pose a threat.

Carcinogenic Risk

Excess lifetime cancer risks were determined for each exposure pathway by multiplying a daily intake level with the chemical specific cancer potency factor. Cancer potency factors have been developed by EPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. That is, the true risk is unlikely to be greater than the risk predicted. The resulting risk estimates are expressed in scientific notation as a probability (e.g. 1×10^{-6} for 1/1,000,000) and indicate (using this example), that an average individual is not likely to have greater that a one in a million chance of developing cancer over 30 years as a result of Site-related exposure (as defined) to the compound at the stated concentration. All risks estimated represent an "excess lifetime cancer risk" - or the additional cancer risk on top of that which we all face from other causes such as cigarette smoke or exposure to ultraviolet radiation from the sun. The chance of an individual developing cancer from all other (non-Site related) causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for Site related exposure is 10^{-4} to 10^{-6} (i.e., 1/10,000 to 1/1,000,000). Current EPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances. A summary of the cancer toxicity data relevant to the chemicals of concern is presented in Section 2 of the RFFS.

Non-Carcinogenic Risk

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). A HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. A HI<1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. A HI>1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI ÷ RfD

where CDI = Chronic Daily Intake and RfD = Reference Dose. CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

Human Health Risk Uncertainty

The non-carcinogenic and carcinogenic risk estimates are subject to numerous uncertainties that may overestimate or underestimate risk. Overall, risks are more likely to be overestimated rather than underestimated. The following bullets summarize the major areas of uncertainty. Please refer to Section 2 of the 2004 RFFS for additional detail.

- Data Quality Issues - no data quality issues have been identified with respect to analysis performed on Site samples.

- RfDs and Cancer potency factors- Several uncertainty factors could be incorporated to address uncertainty resulting from differences between animals and humans, variability among individuals, and other sources.

- Exposure - EPA estimated that exposure to sediment contaminants in the Cocheco River would be limited to 20 days per year due to the steep terrain and difficult access. There are other exposure assumptions that apply to the calculations as well.

Site risks were re-assessed during the preparation of the RFFS using updated toxicity information and exposure assessments. The results of that assessment are presented below.

a. Ground Water

Data from monitoring in summer 2001, fall 2001, and spring 2002 were used to update the ground water risk analysis performed in the RFFS. The risk assumptions used in the 1991 Risk Assessment were changed to conform to present standards and practices. Updated toxicity information was used in these analyses. Table 4, below, summarizes the risk from future ingestion of ground water at the Site.

The primary risk at the Site continues to be future ingestion of ground water. The ground water aquifer is classified as a drinking water aquifer and could be used for drinking water should future development occur in the area. No current risk has existed since the installation of a municipal drinking water system in 1981 and the ordinances were enacted by the City of Dover and the adjoining Town of Madbury in the early 1990's. The primary contaminants in ground water include arsenic and vinyl chloride, which pose 98% and 1% of the total incidental lifetime cancer risk, respectively. Ground water at the Site also contains tetrahydrofuran, benzene and a number of other chlorinated compounds.

Arsenic and THF concentrations have been increasing along the southern edge of the landfill, primarily wells SB-4D and SB-B2, located at the landfill toe and between the landfill and Bellamy Reservoir, respectively. These results indicate contamination in the Southern Plume is increasing and moving towards the Bellamy Reservoir. Further details regarding the increase in contamination in the Southern Plume are contained in Appendix B of the EPA Addendum.

Table 4 below lists both the carcinogenic and non-carcinogenic risks from the relevant contaminants at the Site. Further details are provided in the RFFS and the EPA Addendum to the RFFS.

Table 4: Future Drinking Water Risks in Ground Water at Site[18]

Compound	Scenario	Concentration (ug/l)	Hazard Index	Cancer Risk
Arsenic	Average	180.82	**16.5**	**2.97×10^{-3}**
	Worst-case	654	**59.7**	**1.08×10^{-2}**
Vinyl chloride	Average	4.62	0.0422	7.59×10^{-5}
	Worst-case	26	0.237	**4.27×10^{-4}**
Total, all other Site contaminants	Average	---	0.2428	2.33×10^{-5}
	Worst-case	---	2.633	**1.29×10^{-4}**
Total Drinking Water Risk	Average	---	**16.8**	**3.07×10^{-3}**
	Worst-case	---	**62.6**	**1.13×10^{-2}**

* The bold values are considered by EPA to pose a threat to public health. EPA's acceptable carcinogenic risk range is between 10^{-4} and 10^{-6} and acceptable non-carcinogenic risk is a Hazard Index of 1 or less.

18 RFFS, Appendix I, Tables 3 & 4.

b. Sediments

The contaminants associated with the Site sediments consist of iron and arsenic. These contaminants originated from the landfill leachate by entering ground water in dissolved form, then discharging to a surface water body and precipitating in solid form. Arsenic contaminated sediments were removed from the southern drainage trench as outlined in the 1991 ROD during the 1997 trench and swale restoration (here the term "trench" refers only to the southern drainage trench).[19] Since the removal of contaminated sediments, however, additional arsenic-contaminated sediment has been deposited in these areas from the breakout of leachate from the landfill. Sediments were sampled in November 2002 from the Cocheco River in six traverses.[20] Sediments were sampled from the landfill drainage trenches and drainage swale in an earlier investigation.[21]

The maximum arsenic concentration found in Cocheco River sediment was 1,520 mg/kg on the bank closest to the landfill at transect T3. With respect to human health, this translated into a human health risk of 5.5×10^{-5}, which although within EPA's acceptable risk range of 10^{-4} and 10^{-6}, is still above EPA's point of departure in considering risk (10^{-6}).[22] The non-cancer Hazard Index was calculated as 0.9, just below EPA's acceptable value of 1.

c. Surface Water

The primary surface water impacts are in the drainage trenches, drainage swale, and Cocheco River. The original human health risk assessments by Wehran and HMM in the 1988 and 1990 Remedial Investigations found no excess carcinogenic or non-carcinogenic risk to the public.[23, 24] In the RFFS, the potential surface water risk was re-calculated using current, approved methods and data gathered during the May 2002 Site sampling round. This re-calculation found that the surface water at, and surrounding the Site, still did not pose a risk to human health.[25] Sampling

[19] Remedial Action Summary Report for the Trench and Swale (Close-Out Report), GeoInsight, April, 2002.

[20] Ecological Risk Assessment, attached to the RFFS as Appendix I, Attachment I-3.

[21] Trench and Swale Investigation, GeoInsight, 1997.

[22] National Oil and Hazardous Substances Pollution Contingency Plan ("NCP"), 40 C.F.R. § 300.430(e)(2)(i)(A)(2).

[23] Field Elements Studyfor the Municipal Landfill, Dover, New Hampshire, HMM Associates, Inc., January 8, 1990.

[24] Remedial Investigation Dover Municipal Landfill, Volume 1. Prepared for New Hampshire Department of Environmental Services by Goldberg-Zoino & Assoc. and Wehran Engineers, November 1988.

[25] RFFS, Section 2, page 2-16 through 17, January 30, 2004.

results performed in streams that are tributaries to the Bellamy Reservoir in December 2003 did not find VOCs or arsenic in surface water.[26]

d. Soil

The landfill cover is visually inspected at least annually. Much of it is now vegetated with grassland plants and appears to be a meadow with various tree species appearing in the northeast corner. The cover remains intact and continues to provide a barrier to dermal contact with contaminated soils. A chainlink fence parallels Tolend Road; however, this fence is not continuous and is only designed to restrict vehicular traffic, not pedestrian access. Although the landfill is easily accessed on foot, there are no exposures to the waste materials at the surface to human or ecological receptors. However, the current soil cover allows precipitation to enter and leach through the waste beneath the cover, contaminating the groundwater.

e. Air

Outside air emissions at the landfill have not exceeded regulatory levels to date. Indoor air exposure to VOCs in buildings in the area of the Eastern Plume have been assessed using criteria developed by NHDES to assess the potential for indoor air impacts from contaminant plumes. There did not appear to be a risk based on those criteria.

2. ECOLOGICAL RISK ASSESSMENT

The 1991 ROD did not have an ecological risk assessment performed to determine the risk to the environment. However, the 1991 ROD did develop criteria, using the National Oceanographic and Atmospheric Administration (NOAA) standards, to identify sediments that may affect aquatic life. The 1991 ROD specified that contaminated sediments containing more than 50 ppm of arsenic would likely affect aquatic life and therefore must be removed.[27]

EPA's protocol for assessing ecological risk is a tiered approach, the first tier, performed as part of the RFFS, consisted of obtaining the whole-sediment contaminant concentrations. Arsenic is the only contaminant at the Site that is present in the appropriate media and in concentrations sufficient to pose a potential ecological risk. For ecological risks, numerical criteria for protective contaminant concentrations in sediments are based on screening levels established by the NOAA for estuarine and marine biota and the Ontario Lowest Effect Levels for freshwater biota, both of which are accepted by EPA and NHDES for use as screening guidance.[28]

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[26] Pers. comm. by fax, Michael Webster to Darryl Luce, February 11, 2004.

[27] 1991 ROD, page 50.

[28] Screening Quick Reference Tables, Version 2, http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html, NOAA. Ontario Lowest Effect Levels 1993, 1994.

Elevated levels of arsenic were found above threshhold sediment levels (and the terrestrial wildlife benchmarks for soil) in the southern drainage trench as well as in three locations on the Cocheco River, with the highest levels at the south central toe of the landfill and in sediments on the eastern bank of the Cocheco River. These levels indicate there is a potential for ecological risk. Because the arsenic concentrations in sediment exceeded the Ontario threshold level of 8.2 micrograms per kilogram (parts per million), the testing will move to the second stage to determine if the arsenic is bio-available for organisms to absorb, as part of the pre-design investigations for the Amended ROD. The results of the ecological sediment sampling in the Cocheco River are presented below:

Table 5: Cocheco River Sediment Arsenic Concentrations

Transect	Position in Transect Concentration in mg/kg or parts per million Far (north) bank	mid-river	Near (south) bank	Average	Standard Deviation
1 - (background)	5.6	4.8	4.6	5.0	0.5
2 - (mouth of swale)	3.2	3.6	**42.9**	16.6	22.8
3 (seep 300 feet downstream of swale)	3.8	7.6	**1520**	511	874
4 (800 feet downstream of swale)	3.7	5.1	4.9	4.6	0.8
5 (seep 2,600 feet downstream of swale)	3.2	**11.8**	**51.7**	22.2	25.9
6 (4000 feet downstream of swale)	3.3	7.3	5.1	5.2	2.0
Average of all Transects	3.8	6.7	**271.5**		
sd of all	0.9	2.9	612		
Average (T2 - T6)	3.4	7.1	**324.9**		
sd (T2 - T6)	0.3	3.1	668.4		
sd = sample standard deviation. Bold values exceed the first tier threshold value of 8.2 ppm.					
These are the sediment concentrations in the Cocheco River. Transect 1 is the upstream background value. Succeeding transects are impacted by discharges from ground water and surface water contaminated with arsenic from the site. See Figure 1 in Appendix I of the RFFS or Figure 3 on page 28 for the location of the transects.					

The results shown on Table 5 indicate that arsenic is elevated on the landfill side of the River. Arsenic decreases to nearly background concentrations in the middle of the River and are at background concentrations on the far side of the River. The highest concentrations on the landfill (south) side of the River are at points where ground water seeps into the River and decreases within a short distance downstream. The overall concentrations drop further out in the stream and downstream primarily because arsenic is diluted by the sediment load of the River which dwarfs the sediment generated by the discharge from the Site. Concentrations on the north side of the stream are below the first-tier NOAA guidelines.

H. REMEDIATION OBJECTIVES

The 1991 ROD remedy was designed to satisfy remedial action objectives (RAOs) that were developed in the 1991 Feasibility Study based on the results of the risk assessment.[29] This process was summarized and its conclusions begin on page 23 of the 1991 ROD. The change to the Source Control component of the 1991 ROD remedy necessitated revising the RAO's associated with hazardous waste in the landfill. Further, because remedial action has not begun at the site, all RAO's were reviewed in light of the updated risk assessment performed in conjunction with the RFFS and were updated as necessary to ensure all Site risks would be addressed by the amended remedy.

With two exceptions, since issuing the 1991 ROD, Site risks have not significantly changed. These exceptions are:

1. Sampling in the Cocheco River indicates the potential for human health and ecological risk from arsenic in sediment along the banks of the Cocheco River.

2. New guidance indicates the need to re-assess a potential indoor air risk from VOCs volatilizing from the Eastern Plume.

These potential risks were not identified in the original FS and actions to address them were not included in the 1991 ROD. New ecological assessment criteria and new indoor air guidance dictate that these exposures be examined more thoroughly, and RAOs have been added to address these risks. A full list of RAOs for each media is presented below, comparing the RAOs in the 1991 ROD to those in this Amended ROD:

<u>RAOs for Hazardous Wastes in the Landfill</u>

In order to consider a change to the Source Control component of the 1991 ROD remedy, the RAOs for hazardous wastes in the landfill need to be revised to accommodate this change. Additionally, since remedial measures for localized areas of high contaminant concentrations in the landfill are needed to address potential exposure to any wastes just beneath the soil cap, a new RAO for the landfill is required. The 1991 revised RAO's are shown below:

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[29] Dover Municipal Landfill Feasibility Study, Section 2, HMM Associates, Inc., February 28, 1991.

RAOs Identified in the 1991 Feasibility Study

(a) Eliminate or minimize the continued infiltration of surface waters through the contaminated solid waste and into the ground water.

(b) Prevent direct contact with and ingestion of contaminated solid waste materials present in the landfill.

(c) Comply with federal and State ARARs.

For this Amended ROD, the RAOs for the landfill are adjusted as follows:

(a) Facilitate the treatment of contaminants in the landfill and their transport to ground water and subsequent destruction or capture.

(b) Prevent direct contact with and ingestion of contaminated solid waste materials present in the landfill.

(c) Evaluate additional remedial measures for contaminant source areas that may not be adequately or efficiently conveyed to ground water for destruction or capture.

(d) Implement measures to meet clean closure requirements.

(e) Comply with federal and State ARARs.

If the contingent remedy of capping the landfill is necessary, the RAO's from the 1991 Feasibility Study will be retained.

RAOs for Sediments - On-Site.

Although arsenic contaminated sediments were removed from the southern drainage trench and drainage swale in the 1997,[30] any additional arsenic-contaminated sediment that has subsequently been deposited in these areas from the breakout of leachate from the landfill must be removed.

Therefore, the RAOs developed for sediments in the 1991 Feasibility Study are retained:

(a) Eliminate or minimize the potential human exposure to, and environmental impact from, the contaminated sediments located in the landfill drainage trench and at the outlet of the trench discharging to the drainage swale to the Cocheco River.

[30] Remedial Action Summary Report for the Trench and Swale (Close-Out Report), GeoInsight, April, 2002.

(b) Eliminate or minimize the migration of contaminated sediments from the landfill drainage swale into the Cocheco River and along the banks of the Cocheco River.

(c) Contain or remove contaminated sediments in a manner protective of human health and the environment.

(d) Comply with federal and State ARARs.

RAOs for Ground Water/Surface Water/Leachate - On-Site

These RAOs are retained from the 1991 Feasibility Study:

(a) Contain and control the generation and migration of impacted ground water and leachate on-Site serving as a source of off-Site ground water and potential surface water contamination and impact to the drainage trenches.

(b) Reduce the total mass of contaminants present in ground water and leachate to MCLs or levels protective of human health and the environment prior to discharge.

(c) Comply with federal and State ARARs.

RAOs for Air

The potential exists for the landfill to pose some risk due to VOC or fugitive dust emissions. Although USEPA concluded in 1991 that the carcinogenic and non-carcinogenic risks from outdoor air exposures were within USEPA's acceptable carcinogenic risk range, remedial action objectives were developed to respond to any potential risk. These RAOs have been modified to include indoor air concerns for this ROD Amendment as follows:

(a) Eliminate or minimize risk to human health due to off-gassing of VOCs contained in the surface water currently flowing through the landfill drainage trenches.

(b) Eliminate fugitive dust emissions from the landfill.

(c) Eliminate or minimize the potential risk to human health from migration of VOC vapors from the ground water into the basements of existing homes or future structures should additional development occur in the area.

(d) Comply with federal and State ARARs.

RAOs for Ground Water/Surface Water - Off-Site

Contaminated ground water has migrated in two separate plumes from the Site posing a risk to future drinking water use and potential surface water impacts. The Eastern Plume discharges contaminants to the Cocheco River which, although it does not pose a risk to human health from exposure to the surface water, may pose a risk to human health and ecological receptors through exposure to sediment contamination resulting from Site ground water discharges. The Southern Plume migrates towards the Bellamy Reservoir and may ultimately discharge contaminants to the Reservoir. Therefore, remedial action objectives were developed in the 1991 ROD to respond to these potential threats. These RAOs will be retained for this ROD Amendment, and are as follows:

(a) Eliminate or minimize the levels of contaminants in the ground water and leachate emanating from and down-gradient of the landfill. The off-Site contaminated ground water will be compared to MCLs. If no MCL or non-zero MCLG exist, a target level for treatment of that contaminant will be used. This target level will be established at a level which is protective of human health and the environment.

(b) Eliminate or minimize the threat posed to the public health and surrounding environment by the current extent of the contaminated ground water, including potential indoor air exposures.

(c) Prevent the discharge of impacted ground water from the Site from entering surface water bodies above concentrations that are protective of human health and the environment.

(d) Comply with federal and State ARARs.

Sediments - Off-Site (Cocheco River)

The 1991 Feasibility Study did not identify remedial action objectives for off-Site sediment. However, recent sampling in areas impacted by ground water migrating from the landfill has indicated that human health and ecological impacts are possible. Therefore, new RAOs for sediments in the Cocheco River were established for this ROD Amendment and area as follows:

(a) Eliminate or minimize any impact from arsenic-contaminated sediments in the Cocheco River to human health or ecological receptors.

(b) Comply with federal and State ARARs.

I. DESCRIPTION OF REMEDIAL ALTERNATIVES EVALUATED

Within this section are the four remedial alternatives that were evaluated for this Amended ROD to address the Site contamination. Details of the development of these alternatives are provided in the RFFS and the EPA Addendum.

1. SUMMARY

The outline below summarizes the components of each of the four alternatives considered. A more detailed explanation follows the summary. Since the No-Action Alternative was evaluated in the 1991 ROD and found to fail the threshold criteria, it is only provided in this summary for informational purposes and will not be carried through the rest of the analysis. See pages 26 and 32 of the 1991 ROD.

1. No Action Alternative
   1. SC-1: Source Control, no action with respect to the landfill or leachate generated by it.
   2. MM-1: Management of Migration, no action with respect to the contaminant plumes or their ultimate discharge points, the drainage trenches, drainage swale, Cocheco River, and Bellamy Reservoir.

2. 1991 ROD
   1. SC-7/7A: Source Control, capping of the landfill and interception and treatment of the ground water leachate.
   2. MM-2/4: Management of Migration, has two components: MM-2 is Natural Attenuation of contaminated ground water in the Eastern Plume with a contingency for active treatment. MM-4 consists of pumping and treating the contaminated ground water in the Southern Plume that is migrating towards the Bellamy Reservoir.

3. Proposed Alternative
   1. SC-A: Source Control, the landfill remains uncapped with a soil cover in place and an air-sparging trench captures or degrades all contaminants with a contingency for capping and dewatering.
   2. MM-2: Management of Migration, Monitored Natural Attenuation of the Southern and Eastern Plumes.

4. Proposed Mixed Alternative
   1. SC-A: Source Control, as in the Proposed Alternative, the landfill remains uncapped with a soil cover in place and an air-sparging trench captures or degrades all contaminants with a contingency for capping and dewatering.
   2. MM-2/4: Management of Migration, same as the 1991 ROD Management of Migration.

2. COMMON ACTIVITIES

Several actions are common to all alternatives except the No Action alternative and are therefore not listed in the following summary. These common activities are listed below:

Institutional Controls

Institutional controls preventing the use of groundwater and prohibiting activities that will disturb the marine clay layer beneath the landfill are in place. Additional institutional controls will be required that prohibit altering the landfill such that it creates a risk or interferes with the cleanup.

Pre-Design Investigations

Several Pre-Design Investigations (PDI) are necessary prior to implementation of any of the remedy components. These investigations are needed to ensure that all risks at the Site are addressed in the most efficient and effective manner. The RFFS and the EPA Addendum indicate that there are several data gaps that require further investigation. A description of the PDIs and work needed to implement the amended remedy at the Site and ensure protectiveness are presented in Section K of this Amended ROD.

Monitored Natural Attenuation

The 1991 ROD selected Natural Attenuation (NA) to address the Eastern Plume with a contingency that, assuming source control is implemented and functioning, an active restoration system would be evaluated and implemented if ground water cleanup levels were not attained in 5 to 7 years or if levels significantly increased in that time frame.[31] Two alternatives evaluated for this Amended ROD use Monitored Natural Attenuation (MNA) as a treatment for one or both of the ground water plumes. Since the 1991 ROD, EPA has issued a guidance document formalizing NA as a remedy and also renaming it MNA.[32] The MNA remedy now contains specific protocols to verify and monitor cleanup progress. This guidance has been included in the ARARs section of this Amended ROD; therefore, the Management of Migration portion of the remedy for the Eastern Plume, previously referred to as NA will now be known as MNA and will be implemented consistent with the MNA guidance.

Contingent Remedies

Contingent remedies are developed and proposed to provide a back-up remedy in the event that an innovative remedy or MNA remedy fails. A contingent remedy is an accepted, dependable remedy with proven results and is easily implemented. Contingent remedies are identified within

[31] Record of Decision, 1991, USEPA, page 57.

[32] *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites.* OSWER Directive 9200.4-17P, April 21, 1999

this Amended ROD, the RFFS, and the EPA Addendum to facilitate rapid implementation of a contingent remedy if any innovative technology fails. All Alternatives proposed in the RFFS and the EPA Addendum have contingent remedies for the components that are outlined below. A more detailed description of the contingencies in the amended remedy are presented in Section K. 2. of this ROD Amendment. An outline of the media and remedial technologies for which contingency remedies are proposed include:

(1) MNA in the Eastern Plume with a contingency for active restoration through ground water pump and treat;

(2) Air-Sparging Trench for Source Control with a contingency for a RCRA C cap and ground water interceptor/diversion trench;

(3) Sediment in the Cocheco River with a contingency for excavation; and

(4) Indoor Air in residences along Tolend Road with a contingency for corrective action.

3. THE 1991 ROD REMEDY

The 1991 ROD consisted of a Source Control component, SC-7/7A, and a Management of Migration remedy for each contaminant plume (MM-2 and MM-4, for the Eastern and Southern Plumes, respectively). The components of the 1991 ROD are summarized in Table 6 and a complete discussion is contained in the 1991 ROD beginning on page 46.

Table 6: 1991 ROD Remedy				
Source Control Component				
	Landfilled Waste	**Leachate from Landfill**	**Recovered ground water**	**Treated water**
SC-7	Recontour & cap landfill with impermeable liner	Captured in interceptor / diversion trench	Treatment on-Site	Both discharge to the Cocheco River
SC-7A			Discharged to POTW	
Management of Migration Component				
MM-2	Monitored natural attenuation in the Eastern Plume, to be assessed five years after implementation.			
MM-4	Pump-and-treat of Southern Plume.			

Figure 4 on the following page shows the 1991 ROD Remedy schematically. The area of capping and the ground water remediation areas are generally marked. Figures 11 and 12 of the 1991 ROD show the general construction of the cap and interceptor/diversion trench.

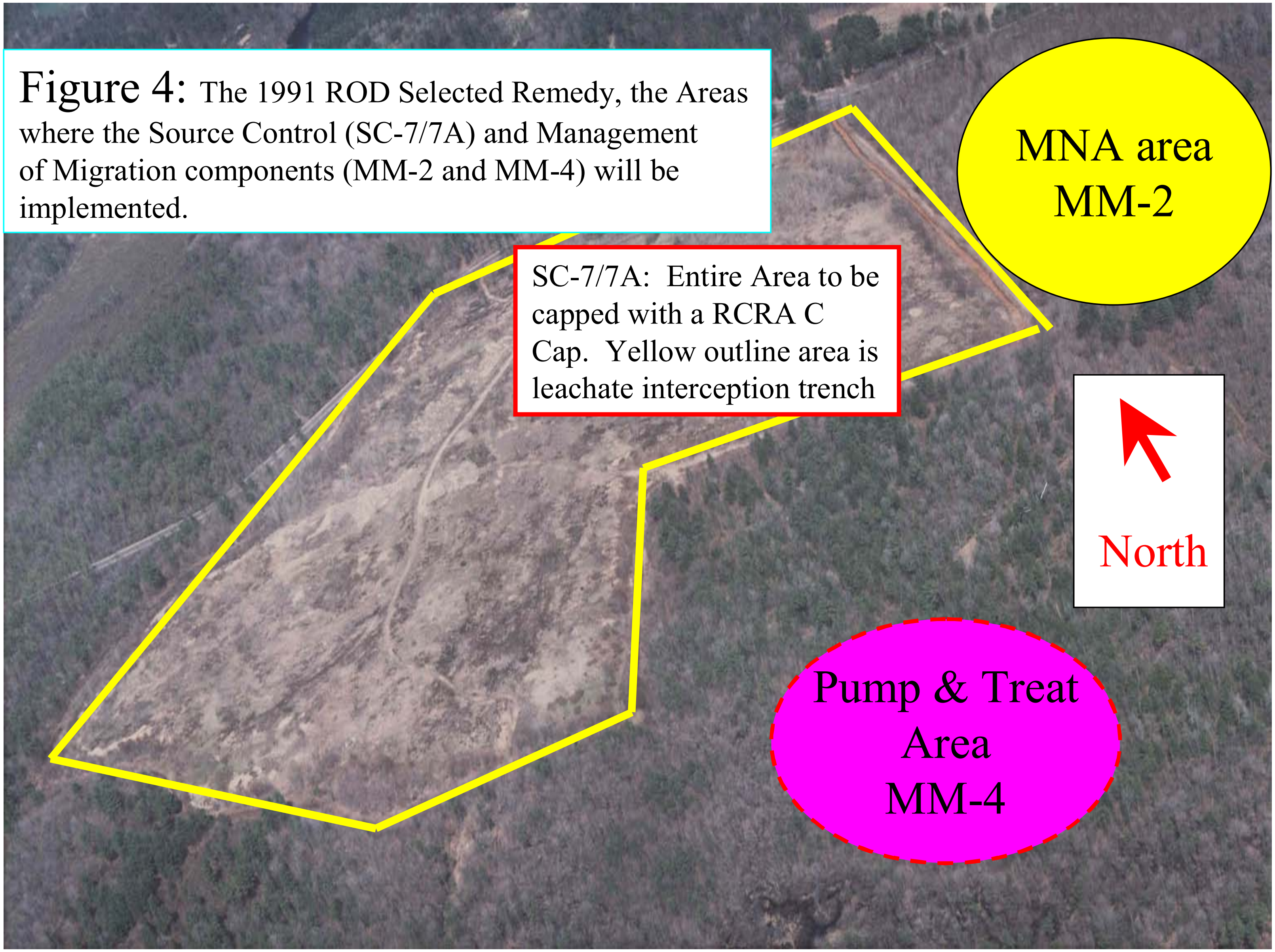
Figure 4: The 1991 ROD Selected Remedy, the Areas where the Source Control (SC-7/7A) and Management of Migration components (MM-2 and MM-4) will be implemented.
SC-7/7A: Entire Area to be capped with a RCRA C Cap. Yellow outline area is leachate interception trench
MNA area MM-2
North
Pump & Treat Area MM-4

4. THE PROPOSED ALTERNATIVE AND THE MIXED ALTERNATIVE

The RFFS presented two alternatives to the 1991 ROD remedy. Both alternatives proposed to change the Source Control component from installing a cap and ground water interceptor/diversion trench (SC-7/7A) to an air-sparging trench. The difference between the two alternatives was in the Management of Migration component for the Southern Plume. The Alternative Remedy proposed to change the 1991 ROD pump-and-treat component for the Southern Plume to MNA. The Mixed Alternative only proposed changes the Source Control component and retains the Management of Migration components of the 1991 ROD. To clarify the changes, Table 7 is offered.

Table 7: Comparison of Alternatives

Media	1991 ROD Remedy	Mixed Alternative Remedy	Alternative Remedy
Landfill	Cap (SC-7/7A) and ground water interceptor trench.	Air-sparging trench (SC-A) with contingency for capping (SC-7/7A).	
Eastern Ground Water Plume	Monitored natural attenuation (MM-2) with contingency for active treatment.		
Southern Ground Water Plume	Pump-and-treat (MM-4)		Monitored natural attenuation (MM-2)

Below is a discussion of each component of the Alternative and Mixed Alternative.

<u>Source Control</u>

The Alternative and the Mixed Alternative incorporate the same change to the Source Control component of the 1991 ROD. Rather than capping the landfill and installing a ground water interceptor/diversion trench, the Alternative and Mixed Alternative leave the landfill uncapped, but install an air-sparging trench around the perimeter of the landfill. Areas of high concentrations of contaminants on and around the landfill will be identified and removed. The drainage trenches along the perimeter of the landfill would be filled. The air-sparging trench would be operated and maintained until leachate contaminated above cleanup levels ceases to flow from the landfill and does not contaminate ground water beneath the landfill above levels that pose an unacceptable risk to human health or the environment. The modeled estimate for the cessation of all contaminants, including arsenic, flowing from the landfill is greater than 100 years. The cleanup time of 100 years or more is based on a number of unsupported assumptions that will be verified during pre-design investigations. It is likely that as the air-sparging trench is operated, a more reliable estimate will become available. Excluding arsenic, the time estimated to cleanup the ground water flowing from the landfill is approximately 30 years.[33] See Section K. 2. *Description of Remedial Components* and Section K. 4. *Expected Outcomes* for further discussion of the components of the Source Control component of the Alternative and Mixed Alternative, and the contingent remedy in the event of failure, respectively.

Management of Migration - Site-wide

The Management of Migration components for both the Alternative and Mixed Alternative contain elements not considered in the 1991 ROD. More specifically, sediments in the Cocheco River will be sampled and evaluated to determine if arsenic in those sediments pose a risk to human health or the environment. If it is determined that an unacceptable risk exists, those sediments will be excavated and disposed off-site. Indoor air was also not considered in the 1991 ROD. EPA will assess whether an unacceptable risk exists in buildings near the Eastern Plume using EPA's recent indoor air guidance.

Management of Migration – Southern Plume

The Alternative proposes to change the Management of Migration component for the Southern Plume from pump-and-treat to MNA. However, EPA did not consider this proposal because it was unsupported by Site data. This conclusion is further discussed in the EPA Addendum. A summary of the most significant problems in considering this change are noted below:

- No demonstration was offered showing that the migration of arsenic would stop.
- Arsenic concentrations in several wells on the southern toe of the landfill exceed the ICL and are increasing.
- Contaminants are above levels protective of human health, and rising, in a well half-way between the landfill and the Bellamy Reservoir, a Class A drinking water reservoir that serves much of southeastern New Hampshire.
- No Site-specific evidence has demonstrated conclusively that ground water contaminants in the Southern Plume would attain drinking water quality before discharging to the Bellamy Reservoir.

For these reasons, a change to the Management of Migration portion of the remedy was not considered for this Amended ROD. Therefore, the Mixed Alternative which retains both Management of Migration components selected in the 1991 ROD, is carried forward to the Comparative Analysis in Section J. 2.

Figure 5, on page 48, depicts a schematic layout of the alternative Source Control component of

[33] RFFS, January 30, 2004. Cleanup times in Section 1.

the Alternative and Mixed Alternative. A schematic representation of the air-sparging trench is offered in Figure 6, which directly follows Figure 5.

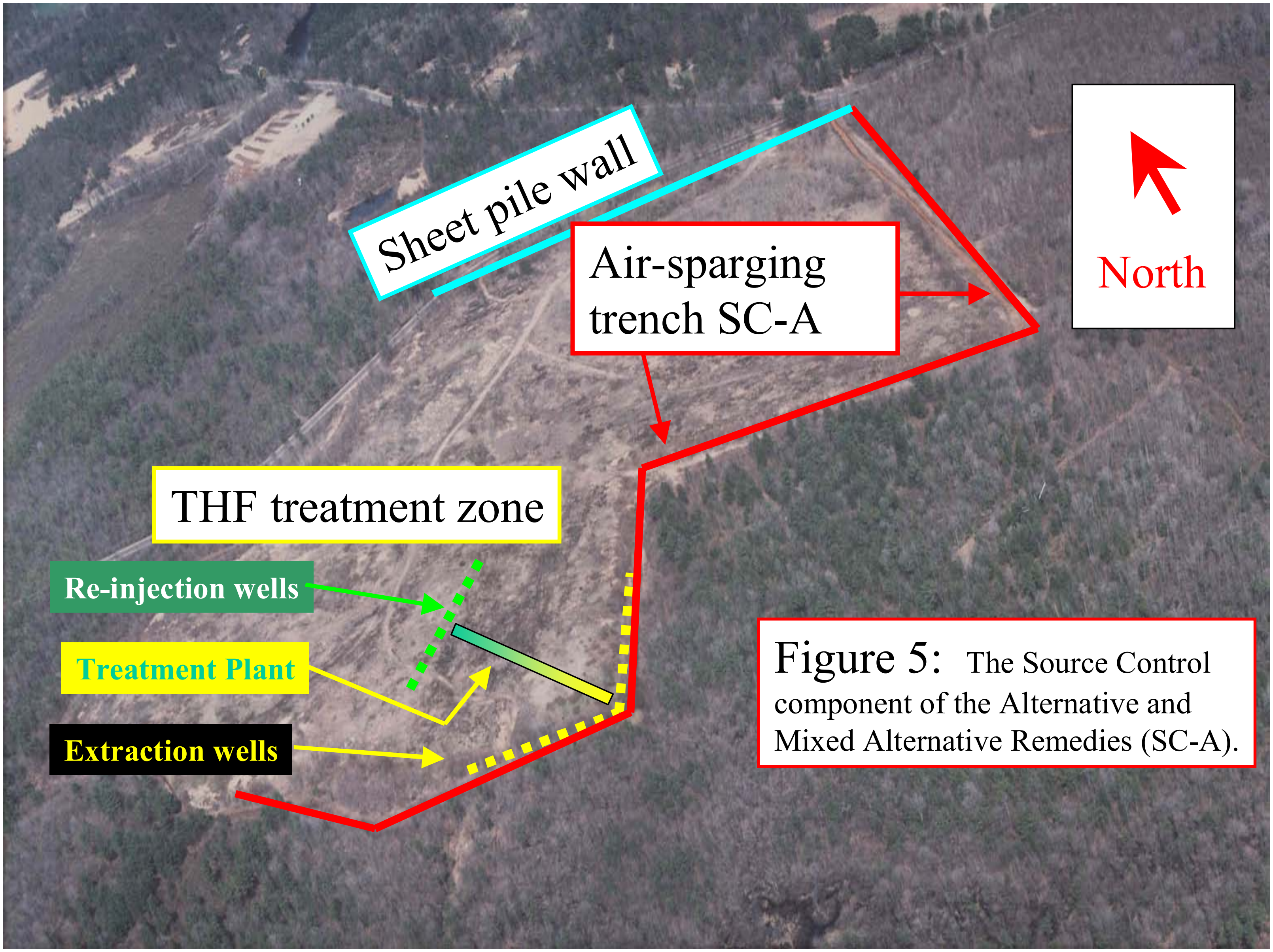

Figure 5: The Source Control component of the Alternative and Mixed Alternative Remedies (SC-A).

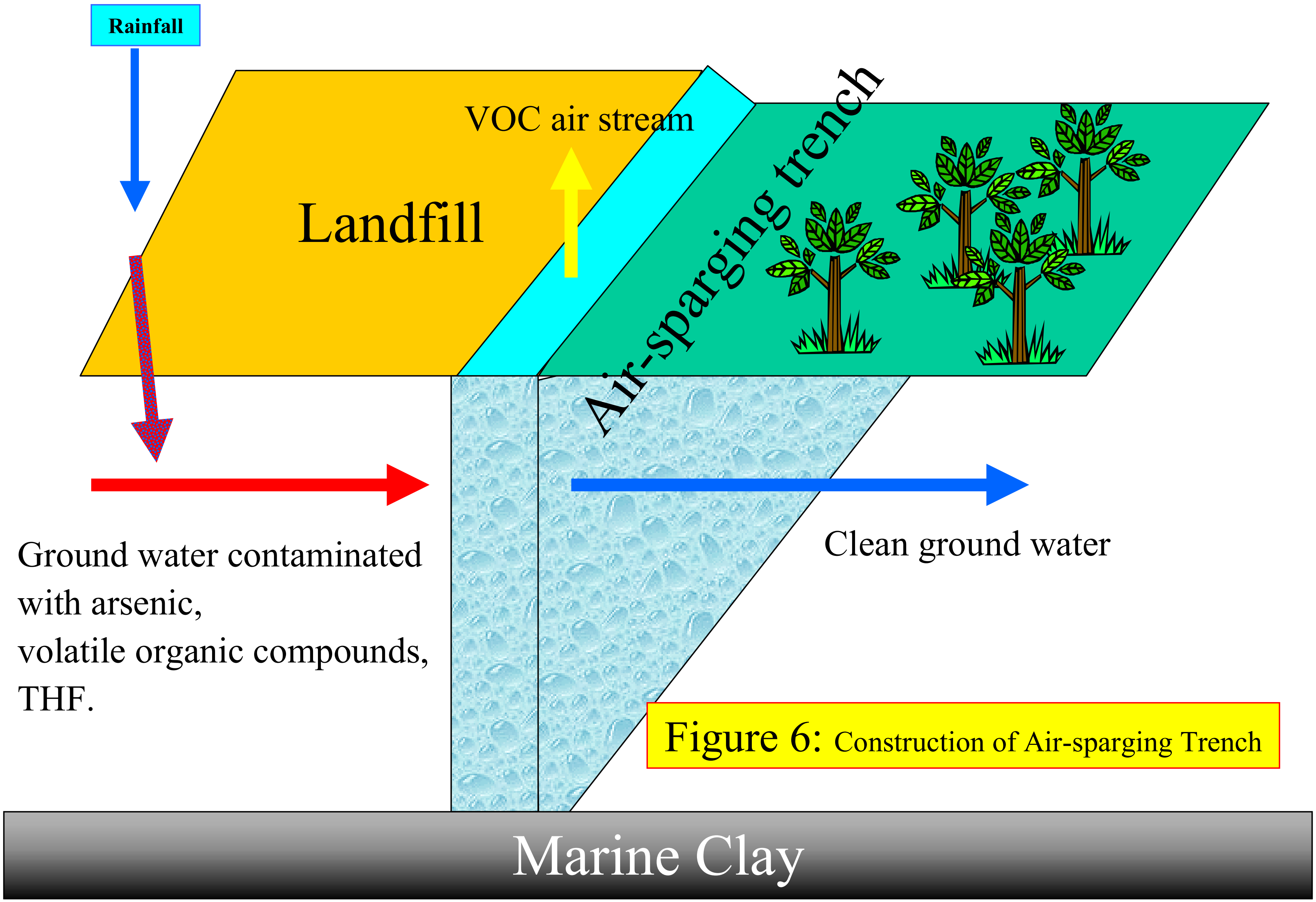

Figure 6: Construction of Air-sparging Trench

J. COMPARATIVE ANALYSIS OF THE 1991 ROD REMEDY AND THE MIXED ALTERNATIVE REMEDY

1. INTRODUCTION

Section l2l(b)(1) of CERCLA presents several factors that, at a minimum, EPA is required to consider in its assessment of alternatives. Building upon these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives.

a. STATUTORY FRAMEWORK

The nine criteria are summarized as follows:

Threshold Criteria

The two threshold criteria described below must be met in order for the alternatives to be eligible for selection in accordance with the NCP:

1. **Overall protection of human health and the environment** addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering controls, or institutional controls.

2. **Compliance with applicable or relevant and appropriate requirements (ARARs)** addresses whether or not a remedy will meet all federal environmental and more stringent state environmental and facility siting standards, requirements, criteria or limitations, unless a waiver is invoked.

Primary Balancing Criteria

The following five criteria are utilized to compare and evaluate the elements of one alternative to another that meet the threshold criteria:

3. **Long-term effectiveness and permanence** addresses the criteria that are utilized to assess alternatives for the long-term effectiveness and permanence they afford, along with the degree of certainty that they will prove successful.

4. **Reduction of toxicity, mobility, or volume through treatment** addresses the degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the Site.

5. **Short term effectiveness** addresses the period of time needed to achieve

protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

6. **Implementability** addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. **Cost** includes estimated capital and operation & maintenance (O&M) costs on a net present-worth basis.

<u>Modifying Criteria</u>

The modifying criteria are used as the final evaluation of remedial alternatives, generally after EPA has received public comment on the RI/FS and Proposed Plan:

8. **State acceptance** addresses the State's position and key concerns related to the preferred alternative and other alternatives, and the State's comments on ARARs or the proposed use of waivers.

9. **Community acceptance** addresses the public's general response to the alternatives described in the Proposed Plan, RFFS, and the EPA Addendum to the RFFS.

b. AMENDED RECORD OF DECISION COMPONENT DESCRIPTION

Because this is an Amended ROD to the 1991 ROD, only that component which is proposed for change (i.e., the Source Control component) will be carried through the comparison in this section. The Source Control components compared are that of the 1991 ROD, capping, and the Mixed Alternative, an air-sparging trench. Migration of contaminated ground water will only be discussed where those issues reinforce an understanding of the Site cleanup effort.

RAO's for the Source Control component at this Site were developed to address wastes in the landfill as well as the leachate that is migrating from the landfill. Source control also includes the contaminated sediments and impacted surface water in the drainage trenches that surround the landfill as well as any outdoor air impacts. The degree to which the risk posed by each of these characteristics is addressed determines the effectiveness and protectiveness of the Mixed Alternative compared to that of the 1991 ROD.

2. COMPARATIVE ANALYSIS

In the following sections each criterion will be explained and then the 1991 ROD remedy Source Control component will be compared to the Source Control component of the Mixed Alternative to determine which best addresses each criterion and to balance the pros and cons of each as it relates to that criterion. The evaluation will examine the components individually and then pull them together in a synopsis of how the components compare to each other under that criterion. Also, in the discussions, the Management of Migration components will be included, not for evaluation, but rather to fully portray the protectiveness of the entire remedy.

THRESHOLD CRITERIA

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

This criterion addresses whether or not an alternative provides adequate protection and describes how Site risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering or institutional controls. This criterion draws on the assessments conducted under other criteria especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. This criterion also considers whether the alternatives pose any unacceptable short-term or cross-media impacts.

ANALYSIS OF SOURCE CONTROL ALTERNATIVES

The 1991 ROD remedy would place an impermeable, RCRA C cap on the landfill. Sediment containing arsenic in concentrations greater than 50 ppm in the drainage trenches and in the drainage swale would be excavated and consolidated under the cap. Any additional hazardous material excavated during remedial activities would also be contained under the cap. The cap prevents dermal contact and nearly eliminates precipitation from leaching more contaminants from the waste into the ground water and migrating off-site. In addition, an interceptor/diversion trench would be installed around the landfill to capture migrating, contaminated ground water that would be treated before discharge. Cap installation, re-contouring and trench installation involves excavation and trucking in an estimated 165,000 cubic yards of fill that will result in short-term exposures to fugitive emissions as well as increased truck traffic. Engineering controls such as dust suppression would control harmful vapors; and truck routes would be arranged to have the least impact on surrounding areas.

The Mixed Alternative would leave the existing natural cover and wastes undisturbed and would allow precipitation to leach through the landfill waste. However, unlike the No-Action alternative, this alternative consists of an air-sparging trench to treat or capture contaminated ground water migrating from the landfill. The effectiveness of the air-sparging trench in addressing organic VOCs is viable and the basic technology has been used successfully at many sites; however, using this technology to address inorganics such as arsenic remains a concern. Specifically, concerns center around adequate mixing of ground water in the air-sparging trench with respect to stripping and mineral precipitation, and the effect of air flow on the backfill material and hydraulic conductivity. There may also be fouling of the backfill material that would require high maintenance activities and/or contingent measures, some of which are also a concern (i.e. acid washing). There are additional concerns about installation of the air-sparging trench at depths greater than 60 feet as proposed in the RFFS and described in the EPA Addendum. Some portions of the air-sparging trench may need to be installed down to 90 feet. In recognition of these uncertainties, the viability of the technology must be demonstrated through effective operation of a portion of the air-sparging trench in an area where depths approach 90 feet before full-scale installation and operation would be allowed. Assuming success, this alternative would act as a treatment mechanism to control contaminated ground water from migrating off-Site to surface waters thereby preventing continued contamination of off-Site ground water. Clean closure would eventually be attained which would effectively eliminate hazardous contaminants from leaching into ground water at levels that pose a threat to human health and the environment. If unsuccessful, the contingent remedy of the 1991 ROD Source Control component will be implemented.

Truck traffic will increase for a short period of time under the air-sparging alternative to remove the approximately 20,000 cubic yards of excavated material and to bring in an equal amount of porous material for the air-sparging trench backfill as well as general construction equipment.

SYNOPSIS OF OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The 1991 ROD Source Control Component combined with active ground water treatment in the Southern Plume would halt the flow of contaminants to the Bellamy Reservoir. The cap prevents precipitation from carrying contaminants off-Site in the ground water while the diversion trench works to lower the water table out of the waste. An active extraction and treatment system in the Southern Plume prevents contaminated ground water from further degrading the aquifer, speeds restoration of the Southern Plume, and protects the Bellamy Reservoir.

The Mixed Alternative, appears to offer a higher level of protection than the 1991 ROD remedy. The air-sparging trench, if properly functioning, will allow flushing and treatment of hazardous substances in the landfill so that ultimately, residual levels of contaminants left in the landfill will no longer pose a risk to human health or the environment. Clean closure, combined with active pump-and-treat in the Southern Plume permanently eliminates Site risks and restores the aquifer.

Both options include institutional controls to prevent the use of ground water, prohibit the disturbance of the marine clay layer, and prevent the alteration of the landfill surface in such a way as to create human health or ecological risk or to impair the cleanup effort. Both must also include a monitoring and assessment, and if necessary, remediation plans for indoor air exposures and for sediment in the Cocheco River to ensure that levels do not exceed acceptable concentration limits for human health or the environment.

Both the 1991 ROD remedy and the Mixed Alternative also have similar short-term impacts to air and the surrounding community from traffic with air stripping having slightly less impact given the lesser volume of material and equipment needed to implement the remedy. Contaminated air would emit from both the capped landfill in the 1991 ROD remedy and from the air-sparging trench in the Mixed Alternative; however, emissions of contaminated air from both structures can be controlled if necessary. Because there is no present risk posed by either of the Source Control components, nor are there any risks that cannot be controlled by engineering techniques, both the Source Control component of the 1991 ROD and the air-sparging of the Mixed Alternative would be protective of human health and the environment.

COMPLIANCE WITH ARARS

Compliance with applicable or relevant and appropriate requirements (ARARs) addresses whether or not a remedy will meet all Federal environmental and more stringent State environmental and facility siting standards, requirements, criteria or limitations, unless a waiver is invoked under CERCLA §121(d)(4). Section 121(d) of CERCLA requires that remedial actions at CERCLA sites at least attain ARARs, unless they are waived.

If an ARAR is not met, the basis for justifying one of the six CERCLA §121 waivers should be discussed. Throughout the RFFS the necessity of considering a waiver for arsenic in ground water is cited several times. The cleanup times for arsenic appear to be, and may very well be, on the order of many decades. However, the modeled cleanup times for arsenic in ground water are subject to a number of assumptions that have not been thoroughly tested and verified. Moreover, the Ground Water and Fate and Transport model provided in Appendix N of the RFFS has not received final approval from the Agencies. Therefore, the estimate of cleanup times made in the RFFS only serve to show the range of cleanup times that may occur with each remedy to better compare the alternatives and are not absolute predictions.

ANALYSIS OF SOURCE CONTROL ALTERNATIVES

The Source Control components are primarily controlled by the New Hampshire Hazardous Waste Regulations which are relevant and appropriate to landfill closure and ground water monitoring. The 1991 ROD incorporates a RCRA C cap, lowering of ground water out of the waste mass and ground water monitoring to ensure the cap is effective in preventing leaching of contamination into the ground water beneath the landfill and preventing off-Site migration. The Mixed Alternative would eventually meet clean closure provisions of the hazardous waste regulations assuming the air-sparging trench is successful in treating contaminated ground water as it leaves the landfill and passes through the trench. As with the 1991 ROD Source Control component, associated ground water monitoring would ensure that the contaminant levels down-gradient of the air-sparging trench are not exceeding ground water cleanup standards. After air-sparging is complete, an appropriate cap in accordance with clean closure regulations will be put in place.

Both alternatives will use best practices to cause the least adverse impacts on wetlands and to restore those areas affected to the extent practicable. Construction of the air-sparging trench may have slightly less impacts on wetlands than the 1991 ROD remedy in that it will temporarily disrupt 2.8 acres and permanently impact 2.2 acres. Also, without a cap, natural water levels are maintained whereas the capping remedy intentionally and permanently lowers the water table out of the waste and in wetlands surrounding the Site. Both the 1991 ROD Source Control component and the Mixed Alternative mitigate wetland damage through re-injection of treated ground water into the landfill (air-sparging) or, in the case of SC-7, discharge to surrounding wetlands (capping or air-sparging). Off-Site discharge to the Dover POTW would negatively impact local wetlands by diverting a significant flow of water out of the watershed of the Bellamy Reservoir. Both options will meet ARARs relating to noise, dust suppression and other potential air emissions through engineering controls.

SYNOPSIS OF COMPLIANCE WITH ARARS

Both the capping and air-sparging remedy would act to eliminate the source of contaminants to ground water in the area. Combining either alternative with MNA in the Eastern Plume is expected to meet ground water ARARs within an acceptable time frame. Although modeling implies that the Eastern Plume will not attain cleanup levels for a significant amount of time, EPA believes that the rate of flow of ground water, coupled with the shift in the ground water environment due to shutting off the landfill source with either the 1991 ROD Source Control component or the Mixed Alternative will yield protective levels in a reasonable time. If it is apparent that cleanup levels will not be attained in a reasonable time in the Eastern Plume, an active Management of Migration remedy will be conducted. The Southern Plume will be addressed through pump-and-treat to bring contaminant concentrations in compliance with ARARs.

Both options meet appropriate discharge or re-injection ARARs through treatment before discharge. Wetlands appear to be disrupted with either choice but both include measures to minimize impacts through the use of best practices and will institute mitigation to the extent practicable through restoration. All air emissions will be monitored Site-wide to ensure air ARARs are not exceeded.

Further, for each alternative, indoor air levels will be monitored consistent with EPA's recently issued indoor air guidance and sediment monitoring will be carried out consistently with NOAA sediment guidance. Both options incorporate action to address any risk found at the site through the monitoring/assessment actions.

Table 1 of Appendix I identifies the ARARs for all alternatives and explains the action to be taken to meet the ARAR.

PRIMARY BALANCING CRITERIA

LONG-TERM EFFECTIVENESS AND PERMANENCE

Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain following remediation and the adequacy and reliability of controls.

ANALYSIS OF SOURCE CONTROL ALTERNATIVES

The 1991 ROD Source Control component would entomb hazardous wastes beneath an impermeable cap, with no bottom liner or leachate collection system, that would be protective as long as it was properly maintained. Waste containment coupled with the ground water interceptor/diversion trench prevents further migration of contaminated ground water off-site to the aquifer and to surface water bodies. There will be permanent impacts on surrounding wetlands; however, these impacts will be mitigated through wetland replication.

Air-sparging in the Mixed Alternative would flush contaminants from the landfill, eventually reducing leachate emanating from the waste to concentration levels in ground water that will not pose a risk to human health or the environment. An appropriate cap would be installed at the completion of the remedy. Implementation of this alternative also results in permanent impacts to the wetlands that can be mitigated.

Both options generate hazardous waste treatment residuals that may require off-site disposal at a hazardous waste facility. Capping would continually generate sludge containing arsenic and organic contaminants in the ground water interceptor/diversion trench. Air-sparging would also generate residual materials in the air-sparging trench consisting primarily of iron with minor amounts of arsenic and could potentially generate substantially more residual waste than the capping should the backfill for the air-sparging trench become fouled with arsenic sludge and excavation and off-Site disposal be required.

The Mixed Alternative appears to offer a higher level of long-term effectiveness than capping in that once air-sparging is complete, the entire 50-acre landfill will achieve clean closure and no hazardous contaminants will be left within the landfill that could pose a risk. While air-sparging may take decades to attain this condition, capping, although potentially constructed in two years, would contain hazardous waste beneath its low-permeability cap for a century or perhaps longer. Additionally, capping requires that the interceptor/diversion trench system be operated for that same extremely long period of time to keep the waste out of the water table.

SYNOPSIS OF LONG-TERM EFFECTIVENESS AND PERMANENCE

The 1991 ROD remedy would retain hazardous materials under the cap for a longer period than the air-sparging alternative and would require continual pumping in the diversion trench to keep the water table out of the waste mass. In addition, the cap will require perpetual maintenance. The Mixed Alternative provides a greater degree of long-term protection in that the landfill will eventually reach clean closure, permanently eliminating the need for cap maintenance or for continuous operation of the ground water interceptor/diversion trench. Alternatively, the air-sparging technology is somewhat speculative when applied to the three processes necessary to address Site contamination. Implementing either alternative will greatly assist the Management of Migration component of the remedy with air-sparging being more beneficial and conducive to movement of the contaminants from the source through its flushing action.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies and addresses the degree to which alternatives employ recycling or treatment, including how treatment is used to address the principal threats posed by the Site. This criterion focuses on the following factors:

- Treatment processes and what they will treat.
- Amount of hazardous materials treated or destroyed and how the principle threat is addressed.
- Degree of expected reduction in toxicity, mobility, or volume (as a percentage).
- The degree to which treatment will be irreversible.
- The type and quantity of residuals that will remain following treatment.
- Does the remedy satisfy the statutory preference for treatment as a principle element.

ANALYSIS OF SOURCE CONTROL ALTERNATIVES

The 1991 ROD Source Control component will reduce mobility by greatly reducing infiltration into the landfill wastes through the impermeable cap. However, contaminants will still reside in the landfill under the cap at the same toxicity and may still migrate, albeit much more slowly, either downward to the marine clay or laterally to the ground water diversion/interception trench where they are slowly captured and treated. Treatment residuals consist of sludge from the leachate collection and treatment system which will be disposed off-site.

The Mixed Alternative will continue to allow contaminants in the landfill to become mobile until they come into contact with the air-sparging trench where these contaminants will be captured and destroyed. Assuming success, air-sparging will permanently reduce the toxicity, mobility and volume of the organic contaminants once the landfill reaches clean closure. The time to achieve this reduction depends on the rate the contaminants are flushed through the landfill and then captured and treated by the air-sparging trench. Removal of arsenic is not as certain in this alternative since the air-sparging trench is an innovative approach for inorganics. The air-sparging trench should reduce the mobility and toxicity of arsenic; however, if fouled, it may require removal of the backfill to clean out the arsenic sludge which must be disposed of off-Site. Alternatively, additional treatment to stabilize the arsenic may be necessary.

SYNOPSIS OF THE REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT

Air-sparging will, if successful, permanently reduce the toxicity, mobility and volume of landfill contaminants once the remedy is complete unlike the 1991 ROD Source Control component which encapsulates and contains the wastes thereby reducing its mobility, but not the toxicity or volume of waste in the landfill. Both options produce treatment residuals with occasional larger volumes from the air-sparging option should the trench foul and excavation be required. Coupling either Source Control component with active ground water treatment, additionally reduces mobility, toxicity and volume of hazardous substances from the ground water in the Southern Plume.

SHORT-TERM EFFECTIVENESS

Short-term effectiveness addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup levels are achieved. The following factors are important:

- Protection of community from exposure to dust, poor air-quality, and transportation impacts.
- Protection of workers during remedial actions.
- Environmental impacts that result from construction and what mitigative measures may be taken.
- Time until the remedial response objectives are met - an estimate, and it may be segmented, i.e. separating the Eastern Plume from the Southern Plume and landfill.

ANALYSIS OF SOURCE CONTROL ALTERNATIVES

The 1991 ROD Source Control component would generate the greatest short-term risk in that fugitive vapors and odors would need to be controlled during the re-contouring of the landfill wastes. Additional risks would be generated by the truck traffic required for the approximately 165,000 cubic yards of material needed to attain sufficient grades for the landfill cap. However, the cap should have an immediate effect in that the waste beneath it would begin to dry out as soon as the pumps in the diversion trench began operating to lower the ground water table out of the waste. Construction would take approximately 2 years.

The Mixed Alternative would leave the landfill surface as is with the existing vegetated soil cover, although periodic maintenance work would be performed to ensure that no wastes were exposed at the surface. Construction of the air-sparging trench would generate far less truck traffic to bring in the estimated 20,000 to 30,000 yards of material needed for the air-sparging trench. Because the air-sparging trench relies principally on natural processes to treat and convey the contaminants to the air-sparging trench, achieving immediate risk reduction would be longer in this alternative than for the capping alternative. Construction time is estimated to be 1.5 to 2.5 years for installation of the air-sparging trench.

Both Source Control remedies pose environmental impacts with capping having slightly more short-term impacts in that 11 acres of wetlands are temporarily disturbed; the air-sparging alternative temporarily disturbs only 2.8 acres. For mitigation, the 1991 ROD remedy would create a wetland area from the re-contoured wastes, whereas, for the air-sparging option would mitigate to the extent practicable. The capping alternative involving discharge of treated water to the City of Dover POTW would have the greatest short-term impact in that a sewer line must be installed, thereby temporarily disrupting wetlands and local roadways. Both capping and air-sparging require that the existing, southern drainage trench be filled in.

SYNOPSIS OF SHORT-TERM EFFECTIVENESS

On balance, the Mixed Alternative has less short-term impacts than the 1991 ROD Source Control component in that the former would involve an order-of-magnitude less truck traffic and less temporary disruption of surrounding wetlands.

IMPLEMENTABILITY

Implementability addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option. This criterion involves the following factors:

- Construction, operation, and the technical difficulties and unknowns associated with a technology.
- Reliability of technology focuses on the technical problems associated with implementation that will lead to schedule delay.
- Ease of undertaking additional remedial action.
- Monitoring considers the ability to monitor the effectiveness of the remedy and evaluates the risks of exposure should monitoring be insufficient to detect a failure of the remedy.
- Administrative feasibility are the activities that are necessary to coordinate with other offices and agencies.
- Availability of services and materials such as storage capacity.

ANALYSIS OF SOURCE CONTROL ALTERNATIVES

The 1991 ROD Source Control component is a proven technology that is implementable and reliable in terms of maintaining the cap and the ground water diversion/interception trench. Equipment and materials are readily available.

The air-sparging technology, although a proven technology, has several uncertainties related to the processes occurring in the trench and Site conditions. Therefore, air-sparging is not yet a proven technology with respect to its application at the Dover Landfill. Problems may be encountered during construction, particularly with excavation up to 100 feet into the aquifer and with installing pipes and other material at that depth. Additionally, the trench will be capturing VOCs, will be biodegrading tetrahydrofuran to the extent practicable, and will be capturing arsenic through precipitation with iron. All three processes have never been done simultaneously at any site. Monitoring will therefore be more aggressive for this alternative given the need to ensure that no breakthrough occurs and due to its innovative nature. In the event that air-sparging is unsuccessful, the 1991 ROD Source Control component is included as a contingent remedy. One of the primary components of the 1991 ROD contingency, the ground water interceptor/diversion trench, can be easily converted from the air-sparging trench if needed.

SYNOPSIS OF IMPLEMENTABILITY

Both Source Control alternatives are implementable with the 1991 ROD remedy having a distinct advantage over the Mixed Alternative since it is a proven technology and services, equipment, and installation techniques have been available for many years. Air-sparging will require specialized equipment and services for installing the air-sparging trench to depths of close to 100 feet and the combination of the individual elements of the Mixed Alternative have never been used in similar circumstances to those presented at the landfill. For Management of Migration, there are no issues with implementing MNA or its monitoring component; ground water pump-and-treat is a proven technology and can be readily implemented and adapted. Extraction, treatment and discharge of treated ground water has been performed at many sites without problems.

COST

Cost includes estimated capital and Operation and Maintenance (O&M) costs, as well as present-worth costs. Direct capital costs include those for construction, equipment, land and site development, buildings and services, relocation expenses, and disposal. Indirect costs include those for engineering, licences and permits, startup/shakedown costs, and contingencies. Annual O&M costs include operating labor costs, maintenance materials and labor, auxiliary materials and energy, disposal of treatment residuals, purchased services, administrative costs, insurance, taxes, licensing, maintenance reserve and contingency funds, rehabilitation costs, and periodic Site Reviews.

The details of the costs of the remedial alternatives under consideration have been outlined in Section 5 of the RFFS. A summary of the cost of the Source Control components (as well as the costs for MM-2/4) in 2004 dollars are summarized in the table below:

Table 8: Comparison of Costs of Remedial Alternatives Considered

Remedy	Capital Costs	O&M Costs (annual cost)	Present Worth (30 years @ 7%)
No Action	$0	$123,065	$1,527,119
1991 ROD			

Source Control (SC-7)	$25,907,453	$252,000	$29,034,531
Management of Migration (MM-2/4)	$1,010,431	$368,065	$5,577,765
Total for 1991 ROD	$26,917,884	$620,065	$34,612,296
Mixed Alternative			
Source Control (SC-A)	$12,352,909	$283,500	$15,870,872
Management of Migration (MM-2/4)	$475,761	$245,565	$3,522,987
Total for Proposed Mixed Alternative	$12,828,670	$529,065	$19,393,859

STATE ACCEPTANCE

The New Hampshire Department of Environmental Services has reviewed the alternatives under consideration and concurs with the proposed change from the 1991 ROD to the Mixed Alternative described in this Amendment. A copy of the State concurrence letter is attached as Appendix C.

COMMUNITY ACCEPTANCE

The community expressed many concerns regarding the effectiveness of air-sparging as a Source Control remedy, the delay in implementing a remedy at the Site, and the continued flow of contamination in the Eastern Plume. These concerns and any others are addressed in the Responsiveness Summary, provided as Appendix D, and all comments are included in the Administrative Record for the Site.

3. SUMMARY OF COMPARATIVE ANALYSIS

The Site presents a future risk from consuming contaminated ground water for drinking water and a potential risk to human health and the environment from arsenic-contaminated sediment. Potential indoor air risks have yet to be evaluated in accordance with recent EPA guidance. Contaminated ground water is currently flowing toward the Bellamy Reservoir which could degrade the water body and threaten a drinking water resource that serves much of southeastern New Hampshire. Both ground water plumes continue to degrade the drinking water aquifer at the Site. The origin of the contaminated ground water is leachate flowing from the landfill area. Implementation of a Source Control remedy at the landfill will enable ground water to be restored.

The Source Control component of the 1991 ROD remedy would effectively meet the remedial response objectives. However, the Mixed Alternative will capture and treat or destroy Site contaminants, perhaps decades before the 1991 ROD Source Control component and cost half as much. While the Mixed Alternative is an innovative remedy which raises concerns relative to the implementability of this remedy, EPA believes that air-sparging has the potential to succeed at the Site. Moreover, the Mixed Alternative will be phased during construction to ensure that it operates correctly. If the Mixed Alternative fails to fully treat or destroy contaminants migrating from the landfill, the 1991 ROD selected remedy will be the contingent remedy.

A summary of how each Source Control component compares with the NCP nine evaluation criteria follows on Table 9. This Table is extracted from the Proposed Plan.

Table 9: Comparison of Cleanup Alternatives for the Dover Municipal Landfill

	Source Control, Landfill Area Only		
Nine Criteria	**SC-1** **No-Action**	**SC-7/7A** **1991 Selected Remedy**	***SC-A** **Air-sparging Trench**
Overall Protection of Human Health and the Environment			
Compliance with Applicable or Relevant and Appropriate Requirements	No further evaluation		
Long-term Effectiveness and Permanence			
Reduces Toxicity, Mobility, or Volume through Treatment			
Short-term Effectiveness			
Implementability			(some uncertainty)
Cost (only Source Control Component)	$0	$29 million	$15.8 million
State agency acceptance	State concurs with selection of SC-A		
Community acceptance	Discussed in the Responsiveness Summary.		

* This is an innovative remedy which will require that a contingent remedy is identified.

Key	Meets or exceeds criterion	
	Partially meets criterion	
	Does not meet criterion	

K. THE SELECTED REMEDY

EPA has selected the Mixed Alternative as providing the best balance between the nine criteria. The selected remedy combines the new Source Control components (SC-A) with the existing Management of Migration components (MM-2/4) into a comprehensive remedy that ensures protectiveness of human health and the environment, attains all federal and state regulations, provides long-term and short-term effectiveness, is implementable, and reduces toxicity, volume, and mobility through treatment.

1. DESCRIPTION OF THE REMEDIAL COMPONENTS

The selected remedy consists of the following components:

Landfill Cover

The present landfill cover consists of a layer of sand and soil over the existing wastes. This natural cover has been in place for over twenty years. In some of the areas the cover has been in place longer, such as the northeast corner. Over the past twenty years the landfill cover has been naturally vegetated with meadow grasses in the central and western portions of the landfill. In the eastern area of the landfill poplars, beeches, birches and sumac have grown up and established wooded areas. This natural cover will be periodically inspected, maintained and augmented where necessary to isolate wastes from trespassers. Areas of erosion or where a lack of organic material prevents vegetative growth will be patched with soil and seeded with annual grass seeds or erosion control matting sufficient to allow native grasses and other forbs to cover the landfill surface. Invasive species will be controlled and not allowed to propagate.

Eliminating Source Areas in and Near the Landfill

The landfill contains areas of high contaminant concentrations (localized sources) that may not be captured or addressed by the air-sparging trench and therefore cause an excess risk to human health or the environment, or violate ARARs. There are currently two known areas of high concentration in or near the landfill that act as localized sources of contamination to ground water and surface water. The first area of high concentration to be addressed is located in the northwest corner of the landfill and manifests itself as high surface water concentrations of volatile organic contaminants such as *cis*-1,2 dichloroethylene and vinyl chloride in an intermittent stream (the northern drainage trench) sampled as SW-E. This contaminated source area will be delineated and removed either through excavation or other *ex situ* techniques.

The second area of high concentration is located in ground water in the southwestern corner of the landfill. The ground water in this area is contaminated principally by THF with concentrations that may overwhelm the treatment capacity of the air-sparing trench . This area will be defined and addressed through a ground water extraction and treatment system designed to attain cleanup levels. Treated ground water will be re-injected into the landfill at an up-gradient location.

During the pre-design investigation for the air-sparging trench, the surface and subsurface area of the landfill will be examined to identify additional areas of high concentrations that may be removed more effectively through localized action or that may breakthrough the air-sparging trench. These areas will either be excavated or addressed by other *ex situ* techniques or, if in ground water, pumped and treated prior to re-injection into an up-gradient portion of the landfill.

Air-Sparging Trench

The air-sparging trench would be installed from the northeast area of the landfill, heading south along the landfill's eastern edge, then turning and following the limit of waste on the southern side of the landfill to the western side of the landfill, a distance of approximately 3,000 to 4,000 linear feet. The depth of the air-sparging trench would be determined by the depth to the marine clay layer where the trench would key into. In some places the trench may be up to 90 feet deep, or more. The objective of the trench is to intercept contaminated ground water from the up-gradient, landfill side of the trench, allow that contaminated ground water to pass though the trench material for treatment, then exit the down-gradient side of the trench at concentrations that do not exceed cleanup levels.

Following the path shown on Figure 5 on page 48, the volume of soil excavation, assuming a three-foot wide treatment zone that spans the upper sand and upper-interbedded aquifers, is approximately 19,000 cubic yards. The air-sparging trench will intercept, capture or destroy contaminants in leachate emanating from the landfill. Although this is similar in nature to the interceptor/diversion trench described on page 54 of the 1991 ROD, its construction, operation, and goals are very different. The air-sparging trench will not serve to extract water for *ex situ* treatment as in the 1991 ROD. Instead, water will be treated in the air-sparging trench to immobilize arsenic, capture VOCs in the air stream and extract them, and to aerobically degrade THF. Air emitted from the air-sparging trench is not expected to require treatment; however, the stacks may be retro-fitted with treatment devices if necessary.[34] For cost purposes, it is estimated that this air-sparging trench will operate for at least 30 years; however, the air-sparging trench must remain operating until the landfill has reached clean closure. There are a number of sub-components to this portion of the remedy:

1. Construction of a hydraulic barrier along the northeast half of the landfill to direct leachate emanating from the landfill through the air-sparging trench. This will divert ground water through the eastern portion of the air-sparging trench that would otherwise flow off-site to the north.

2. The air-sparging trench will be constructed in phases or segments that may be operated independently. As a part of pre-design investigations, EPA and NHDES will select the segment(s) to be constructed first. Although air-sparging will be the primary mode of operation, design flexibility may enable portions of the air-sparging trench to be operated

[34] RFFS, January 30, 2004, page 4-27.

as a ground water extraction trench or, if appropriate, a re-injection trench. Monitoring and maintenance of the air-sparging trench will be required during operation to ensure that potential fouling is identified and corrected quickly. The path of the air-sparging trench will follow the edge of waste at the landfill. The air-sparging trench will be operated as described below:

- As groundwater passes through the trench, air-sparging will capture VOCs such as vinyl chloride, and 1,2 DCE, as well as hydrocarbons such as benzene in the ground water. Captured VOCs and hydrocarbons will be discharged to the atmosphere if they are below regulatory criteria. If not, they will be captured on activated carbon filters for destruction and offsite disposal. Concentrations of contaminants in the ground water exiting the down-gradient side of the air-sparging trench are expected to be at cleanup levels.

- The aerobic environment created by the air-sparging trench will allow micro-organisms to degrade THF. This aerobic environment will also precipitate iron which then combines with arsenic so that arsenic concentrations in ground water should reach cleanup levels before it exits the down-gradient side of the air-sparging trench.

- Should arsenic cause fouling in the trench, it will be removed by excavating the air-sparging trench from the aquifer or removed by other, proven technologies. Arsenic will similarly be removed from the trench at the conclusion of the Source Control component.

See Section K. 4., *Expected Outcomes* for further discussion regarding the air-sparging trench contingency in the event of failure. A schematic representation of the air-sparing trench is offered in Figure 6 on page 49.

Monitoring and Removing Contaminated Sediments

Arsenic-contaminated sediments are located in the landfill drainage trenches and drainage swale as well as in the Cocheco River. Sediments in the drainage trenches and swale above the 50 ppm arsenic cleanup level will be excavated and disposed of at an approved off-site facility. The trench surrounding the landfill will be eventually backfilled, therefore no future monitoring is required. However, the drainage swale may still accumulate arsenic-contaminated sediments; therefore, annual monitoring of the sediments will be required. Should sediment with concentrations exceeding cleanup levels become redeposited, it shall be excavated and disposed of at an approved offsite facility.

Cocheco River sediments will be assessed annually to determine whether or not they pose a risk to human health and the environment. Currently these sediments fall within EPA's risk range for human health but the concentrations were beyond EPA's point of departure for carcinogenic risks and near EPA's threshold for non-carcinogenic risks. For ecological risk, the sampling results did not pass the first tier of the ecological risk assessment making it necessary to move to the next tier, toxicity testing. Therefore, it is appropriate to establish and maintain a sediment sampling program both within the pre-design investigations and in future site environmental monitoring.

MNA in the Eastern Plume

This component of the remedy is retained from the 1991 ROD and the reader is referred to page 56 of the 1991 ROD for a fuller description. However, through this Amended ROD, attenuation of contaminants in this plume will be monitored and otherwise addressed in accordance with EPA's guidance for MNA remedies. Further, should EPA determine that MNA for this plume is unsuccessful, a contingent remedy of pump-and-treat shall be implemented. See Section K. 4. b. (2) of this document for more details of the contingent remedy.

Pump and Treat in the Southern Plume

As with the Eastern Plume, the remedy for the Southern Plume is retained from the 1991 ROD and the reader is referred to page 55 of the 1991 ROD for a fuller description. Pre-design investigations associated with this component are outlined above in this section. Treated ground water will be discharged to area wetlands or the Dover POTW.

Indoor Air

EPA's recent guidance regarding indoor air requires that buildings located in areas near the Eastern Plume be evaluated for VOCs that may pose a risk to human health. This evaluation shall be conducted within 9 months after signing this Amended ROD. A regular monitoring program for indoor air vapors shall be part of a Site-wide monitoring program. Should concentrations exceed protective levels, a contingency for corrective action is outlined in Section K. 4. b. (4) of this document.

Site-wide monitoring program

As part of this component, a Site-wide monitoring program shall be implemented to monitor indoor and outdoor air, soil, sediment, ground water and surface water. There will be two sections of monitoring. First, the existing Environmental Monitoring Plan shall be modified to demonstrate the state of contamination throughout the Site and to detect migration of contaminants. The second section is Remedy Performance Monitoring which will be conducted to assess the performance of the air-sparging trench, natural attenuation in the Eastern Plume, flushing of the landfill, and pump-and-treat in the Southern Plume.

Institutional Controls

To protect the integrity of the remedy and prevent the use of contaminated ground water, institutional controls that prevent the use of ground water, that prevent disturbance of the marine clay layer beneath the aquifer, and that prohibit activities on the landfill surface that may create a human health or environmental risk or that may negatively affect the cleanup, until the cleanup is complete, are necessary. Current local ordinances that prohibit these activities should remain in place until the remedy is completed. A state groundwater management zone should also be put in place at the Site.

2. SUMMARY OF THE ESTIMATED REMEDY COSTS

The selected remedy has a total cost estimate of $19.4 million. This cost may be broken down further into the Source Control and Management of Migration components. Additionally, there is the added component for 30 years of operation and maintenance costs. Thirty years is used as a standard because projections past that point become very speculative. Not factored into the cost shown in Table 10 is that the project will be phased to ensure that the remedy is viable. Phasing the remedy may incur additional costs; however, it is more likely to save money since design issues will be addressed using data based on field conditions. Table 10, below outlines the estimated cost of the selected remedy:

Table 10: Estimated Cost of the Selected Remedy			
Component	**Capital Costs**	**O&M Costs (annual cost)**	**Present Worth (30 years @7%)**
Source Control[a]			
Details of Air Sparging	Preparation: $1,048,000 Trench: $6,477,000 Barrier: $2,005,000 Sediment Tox testing:$50,000 Start up: $145,600	Maintenance: $185,000 Utilities: $55,000 Operator & misc.: $43,500	
Source Control (SC-A)	$12.4 million[b]	$283,500	$15.9 million
Management of Migration[c]			
Details of MNA and Pump and Treat	Institutional Controls: $10,000 Southern Plume pump & treat construction $364,615 Long-term monitoring - to be determined after predesign investigations.	Institutional Controls: $20,000 Long-term monitoring: $123,065 Operation and maintenance: $102,500	
Management of Migration (MM-2/4)	$475,761	$245,565	$3.5 million
Total for Selected Remedy	$12.8 million[d]	$529,065	$19.4 million

[a] The detailed costs are shown on Table 5-18, Page 5-111 of the RFFS.
[b] This cost also includes 10% contingency, 5% project managment, 6% remedial design, and 6% for construction management.
[c] The detailed costs are shown on Table 5-18, Page 5-113 of the RFFS.
[d] Costs for pre-design investigations outlined in Section K. 3. are not included in this estimate.
[e] Costs are +50/-30 as set forth in EPA's Feasibility Study guidance.

3. PRE-DESIGN INVESTIGATIONS

Several Pre-Design Investigations (PDI) are needed to fill data gaps identified in the RFFS and the EPA Addendum. Conducting these investigations will ensure that all risks at the Site are addressed in the most efficient and effective manner.

Ground Water Model and Fate and Transport Model PDI: The RFFS contained a Ground Water Model and a Fate and Transport Model which the Agencies have not yet approved and that require modification. Tasks associated with this PDI include collecting field data to determine and verify many of the parameters identified in the models. Because several of the subsequent PDIs listed below require input from these two models, past Agencies' comments deferred for the RFFS as well as any additional Agencies' comments must be addressed prior to conducting additional field investigations associated with the PDIs listed below. The Ground Water and Fate and Transport models will be of maximum importance in designing the air-sparging trench. This PDI will be completed 12 months after this Amended ROD is signed.

Air-Sparging Trench Pre-Construction PDI: This PDI will determine the depth, location and construction methods for the air-sparging trench. A drilling program will determine the structure of the subsurface, the depths to which the trench will need to go, and the nature of the contamination encountered. Based on this and other information, EPA and NHDES will select the number and order of segment(s) to be constructed to demonstrate the viability of the technology. In determining viability, EPA and NHDES will consider factors such as the effectiveness of the trench to immobilize arsenic at its highest concentrations and its effectiveness in attaining cleanup levels of all contaminants emanating from the landfill. This PDI will be completed within 18 months after this Amended ROD is signed.

Southern Plume Pump-and-Treat PDI: Incorporating information from the 1994 PDI for pump and treat in the Southern Plume, this PDI will gather additional field data that will be used to determine, among other things, the placement of extraction wells, the rate at which those wells should operate, and the treatment and discharge of groundwater. This PDI will be completed within 12 months after this Amended ROD is signed.

Northwest Landfill PDI: This investigation will determine the source of high concentrations to surface water sampling point SW-E. It will be completed within 12 months after signing this Amended ROD.

Sediment Assessment PDI: This investigation involves performing the second and, if necessary, third tier of the ecological assessment protocol to determine if arsenic in sediments at the Site are harmful to aquatic life. Subsequent sampling will be performed to ensure that the arsenic and other inorganic contaminants in the sediment do not pose a hazard to human health or the environment. Additional sampling will be conducted for additional elements including mercury, lead and cadmium. This PDI will be completed within 9 months after signing this Amended ROD.

Indoor air assessment PDI: This PDI will be conducted in the area of those residences that overlie or are in close proximity to the Eastern Plume, following EPA's indoor air guidance.[35] This indoor air monitoring will be expanded and included in the Site-wide

[35] Draft *Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (Subsurface Vapor Intrusion Guidance), USEPA, November 26, 2002.

EMP. The first assessment for this PDI will be completed within 9 months after signing this Amended ROD.

Eastern Plume MNA PDI: This PDI will be conducted to determine the rates at which natural attenuation of the contaminants is occurring in order to formulate a long-term monitoring program in accordance with EPA's guidance for monitored natural attenuation.[36] This PDI will be completed within 18 months after signing this Amended ROD.

Outdoor air assessment PDI: This investigation requires sampling outdoor air during and following construction activities to ensure that implementation and operation of the Source Control remedy does not pose a risk to human health from outdoor air. Areas to be sampled include near SW-E (in the northern drainage trench), near the head of the drainage swale and at the bottom of the drainage swale. This PDI must begin at the start of remedial action and must be completed upon EPA's determination that construction is complete.

4. EXPECTED OUTCOMES OF THE SELECTED REMEDY

The selected remedy has several unknowns driven principally by the behavior of inorganic elements and the hydrogeology surrounding the site. The implementation of the Source Control component will alter the geochemistry and hydrogeology of the surrounding aquifer. The geochemistry will be altered by injecting oxygen into an oxygen depleted ground water environment. The primary effect will be the precipitation of iron which will absorb other inorganic elements including arsenic. The intention of the air-sparging trench is to precipitate the iron and other inorganic compounds <u>inside the trench</u>. Precipitating these compounds in the trench is necessary so that they may be removed when either the remedy is complete or if the precipitate compromises the function of the remedy. Precipitation outside the trench is not allowable because once the air-sparging trench ceases operation, the anaerobic environment in the aquifer will cause the precipitate to re-dissolve, potentially generating a high-concentration arsenic plume.

a. CLEANUP LEVELS

(1) INTERIM GROUND WATER CLEANUP LEVELS

Interim ground water cleanup levels were established in the 1991 ROD based on SDWA MCLs, non-zero MCLGs if an MCL does not exist, and more stringent state drinking water standards. Currently, the State of New Hampshire AGQSs are the same as or less stringent than federal drinking water standards; however, if those standards are revised to more stringent levels, the selected remedy would be reviewed for protectiveness in light of any new standard. Because the

[36] *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites.* OSWER Directive 9200.4-17P, April 21, 1999, page 24.

Amended ROD addresses ground water that is in a drinking water aquifer, these interim cleanup levels (ICLs) have been identified as chemical specific ARARs. Reviewing the1991 ground water ICLs in light of the more current applicable or relevant and appropriate standards finds that only arsenic will change. Therefore, the cleanup level for arsenic will change from 50 ug/l to 10 ug/l for ground water cleanup in the selected remedy. Table 11, on the following page, sets out the interim ground water cleanup levels as established for the Amended ROD. As explained on pages 47 and 50 of the 1991 ROD, interim cleanup levels remain in place for the duration of the cleanup. Once the cleanup is complete, final ground water cleanup levels will be established.

Table 11: Ground Water Cleanup Levels and comparison to May 2002 results **(bold values indicate change from 1991 ROD)**				
		May 2002[37]		
Constituent	**1991 ICL (ug/l)**	**# wells > ICL out of 58 wells**	**Maximum (ug/l)**	**Proposed ICL (ug/l)**
Arsenic	50	27 / 45*	634	**10**
Vinyl chloride	2	13	26	2
Benzene	5	29	79	5
Trichloroethene	5	4	17	5
Tetrachloroethene	5	0	5	5
Methylene chloride	5	2	8	5
1,1 DCE	7	0	0.9	7
1,2 DCA	5	0	3	5
cis-1,2 DCE	70	0	14	70
Chloroethane	14000	0	10	14000
Tetrahydrofuran	154	12	2,400	154
Acetone	700	0	88	700
MEK	200	0	8	200
MIBK	350	0	17	350
Toluene	1000	0	310	1000

* 27 of the 58 wells exceed the old cleanup level of 50 ppb, 45 of 58 exceed the new cleanup level of 10 ppb. These data are extracted from the May 2002 sampling round, the latest data at the time of the initial RFFS submittal.

(2) SEDIMENT RESPONSE AND CLEANUP LEVELS

Sediment cleanup levels are derived from NOAA benchmark standards and health-based risk calculations for environmental and human health standards, respectively. Arsenic- contaminated sediments exist in the drainage trenches, drainage swale, and the Cocheco River. The drainage trenches will be covered (following removal of sediment containing arsenic greater than 50 ppm)

37 Summary of Summer 2002 EMP Event, Dover Municipal Landfill, GeoInsight, Westford, MA, November 15, 2002.

with soil under the Amended ROD. The swale will remain uncovered although it may have further alterations based on an existing Operations and Maintenance Plan. The Cocheco River is used for boating and fishing. Based on these considerations, sediments in the Cocheco River have different cleanup standards than those for the drainage trenches or drainage swale.

In the drainage trenches and drainage swale, the 1991 ROD set sediment cleanup levels for arsenic-contaminated sediment based on standards that NOAA had selected at that time (50 ppm) for ecological receptors. This level was reviewed during the preparation of EPA's Addendum and was reconfirmed to be protective of ecological receptors. Therefore, this Amended ROD retains the 50 ppm arsenic cleanup level for the sediments in the drainage trenches and drainage swale. This cleanup level is retained in the drainage trenches because of the continuing presence of burrowing animals that may access deeper sediments as well as to protect other ecological receptors. In addition, leaving sediments 50 ppm or greater in the drainage trenches may result in arsenic becoming dissolved and re-mobilized, thus acting as a continuing source of arsenic to the ground water. The drainage swale will not be covered, leaving sediments available to animals and other ecological receptors as well as acting as a continuing source to ground water. Any sediment in the drainage trenches or the drainage swale that exceed 50 ppm will be excavated and disposed off-Site. With regard to human health risks,the drainage trench no longer provides an exposure pathway; sediments in the drainage swale fall within EPA's acceptable risk range, but continued monitoring will occur to ensure protectiveness.

In the Cocheco River, arsenic-contaminated sediments that exceed either the three-tier environmental protocol or exceed human health based criteria, shall be removed from the stream and disposed off-Site. With regard to ecological risk, sediments in the Cocheco River will be assessed through two methods: whole sediment analysis and toxicity testing. If sediments are shown to have concentrations that exceed human health risk standards through whole sediment analysis, those sediments will be removed. Those same sediments will be tested through toxicity testing for ecological risk using organisms found in the river (Tier 2 testing). If unacceptable impacts are found, the assessment will move to the third tier of testing, ecosystem assessment. If that assessment is unsatisfactory, those sediments will be removed and disposed off-site in accordance with the State of New Hampshire regulations.

b. CONTINGENT REMEDIES

Contingent remedies have been selected for a number of components of the selected remedy. More specifically, contingent remedies are offered for each of the following components:

(1) AIR-SPARGING TRENCH

EPA recognizes that the air-sparging trench is an innovative approach that, although it poses an opportunity to clean up the landfill quicker, also poses some risks of failure. Concern is generated by the depth of the air-sparging trench, up to 100 feet in places, and the complexity of the processes that will occur within it. The air-sparging trench will recover VOCs, degrade THF, and precipitate arsenic for later recovery. No system has previously attempted all three simultaneously. Therefore, the air-sparging trench will require a contingency remedy. The contingency remedy will be that presented in the 1991 ROD for Source Control which consists of capping the landfill with a RCRA C cap and intercepting contaminated ground water at the landfill boundary (i.e., the 1991 ROD alternative SC-7/7A). The following criteria, at a minimum, have been established to evaluate and implement a contingent remedy for the air-sparging trench:

- One year after completing the construction of any phase or segment of the air-sparging trench, should that portion of the air-sparging trench or any other portion of the air-sparging trench fail to immobilize, capture or destroy site contaminants and these contaminants exit the down-gradient side of the air-sparging trench at concentrations that exceed cleanup criteria, regardless of form (dissolved or particulate), the 1991 ROD Source Control component (SC-7/7A) will be implemented.

- If, at any time, operation of the air-sparging trench creates conditions that EPA believes will increase, or not decrease risk at the site, and those conditions are not corrected in what EPA believes to be a reasonable time, the 1991 ROD Source Control component (SC-7/7A) will be implemented. These conditions may include either unfavorable alterations of site hydrogeology or geochemistry, the production of recalcitrant daughter products that generate higher risk, or the creation of any physical hazards.

Monitoring of the air-sparging trench will include clustered wells that for each segment span the treatment zone vertically and are spaced at intervals that EPA believes are sufficient to determine the effective operation of the air-sparging trench. These clusters of wells will be positioned from inside the landfill to the air-sparging trench and to the down-gradient side of the air-sparging trench along the flow path of contaminated ground water. Monitoring will be performed at periodic intervals that EPA believes will provide performance data for each segment and will include both ground water and solid media samples from the air-sparging trench and aquifer. A separate monitoring program will be required to determine if clean-closure requirements have been met at the completion of cleanup.

(2) GROUND WATER CONTAMINATION - EASTERN PLUME

Although this contingent remedy was included as a component of the 1991 ROD, it is repeated and provided further definition here. Because MNA is a component of the Amended ROD, it requires an evaluation five years after construction complete to determine its effectiveness in reducing contaminant concentrations. In addition, a contingent remedy is identified in the event concentration levels are not declining as anticipated.[38] Such a contingent remedy is necessary for the Eastern Plume. The following criteria, at a minimum, have been established to evaluate and implement a contingent remedy for MNA (MM-2):

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[38] *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites.* OSWER Directive 9200.4-17P, April 21, 1999, page 24.

- Five years after EPA determines that construction of the Source Control component is complete, the MNA component for the Eastern Plume, will be assessed by EPA to determine if ground water cleanup has progressed sufficiently to indicate that ground water cleanup levels will be attained in a reasonable time-frame.[39]

- Every five years, thereafter, the MNA remedy for the Eastern Plume will be assessed by EPA to determine if ground water cleanup has progressed sufficiently to indicate that ground water cleanup levels will be attained in a reasonable time-frame.

- If EPA determines at any time that cleanup levels will not be attained in a reasonable time-frame and that a waiver is not justified, a pump-and-treat remedy (MM-4) will be implemented.

The contingent pump-and-treat remedy in the Eastern Plume will extract contaminated ground water, treat it to clean up levels, and discharge it to the Cocheco River. As part of the ground water monitoring program, the monitoring well network surrounding the landfill will be augmented and optimized to determine the extent, laterally and vertically, of ground water contamination. This will include the use of the existing monitoring network as well as the establishment of additional monitoring wells both on the landfill and in the area surrounding the landfill.

(3) COCHECO RIVER SEDIMENT

If further sampling, performed under either the pre-design investigations or future environmental monitoring, demonstrates that sediment in the drainage swale or Cocheco River generates a risk to either human health or the environment, that sediment must be excavated from the drainage swale or Cocheco River and disposed off-site in accordance with State of New Hampshire regulations.

(4) INDOOR AIR

If further sampling, consistent with EPA's Indoor Air Guidance, demonstrates that an indoor air risk exists from contaminants at the Site, appropriate actions will be taken to eliminate that risk.[40]

c. CLEAN CLOSURE OF THE LANDFILL

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39 *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites.* OSWER Directive 9200.4-17P, April 21, 1999.

40 Draft *Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (Subsurface Vapor Intrusion Guidance), USEPA, November 26, 2002.

At the conclusion of the remedy it is expected that hazardous waste in the landfill will no longer leach contaminants into the ground water surrounding and beneath the landfill that pose a risk to either human health or the environment and that no further cleanup actions with respect to the Site will be required.[41] Further activities at the landfill at that time will be subject to State of New Hampshire regulations.

L. STATUTORY DETERMINATIONS

The remedial action selected herein for implementation at the Dover Municipal Landfill is consistent with CERCLA and, to the extent practicable, the NCP.

1. THE SELECTED REMEDY IS PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy will be protective of human health and the environment. Current exposure to contaminated ground water will be prevented through institutional controls. Long-term monitoring of the ground water will allow EPA to track the concentrations present in the Eastern and Southern Plumes. Water quality data will be used by EPA to demonstrate that the plumes are not expanding and that concentrations are declining. Excavating contaminated sediment and then filling in the existing northern and southern drainage trenches prevents direct contact with the contaminated leachate and sediment. Any short-term risks to human health or the environment during implementation of the selected remedy are controllable through engineering techniques. The potential exposure to Site workers and area residents to air emissions during the installation of new monitoring wells, extraction wells, or the air-sparging trench will be monitored to ensure ambient air levels are not exceeded.

Air-sparging of ground water is expected to reduce (and eventually eliminate) the concentration of contaminants from ground water flowing into the surrounding aquifers. Operation of a pump-and-treat ground water system, in conjunction with the Source Control component, will eventually restore the aquifer south of the landfill to drinking water quality and also protect the Bellamy Reservoir from becoming impacted by the landfill contamination. Similarly, the use of monitored natural attenuation, in concert with the other Source Control components, will eventually restore the aquifer to the east of the Site to drinking water quality.

2. THE SELECTED REMEDY ATTAINS OR APPROPRIATELY WAIVES ARARs

ARARs for the Site were identified during the development of the 1991 ROD. As part of the evaluation of alternatives for this Amended ROD, not only were new ARARs associated with the proposed alternatives identified, but a review of the previous ARARs was conducted. A complete

[41] Risk-Based Clean Closure. USEPA, Elizabeth Cotsworth, Acting Director, Office of Solid Waste, March 16, 1998.

list of ARARs is presented in Appendix A of this Amended ROD.

Section 300.430 (e) of the National Contingency Plan (NCP) requires that on-site remedial actions at CERCLA sites must meet ARARs under federal or state environmental or facility siting laws unless there are grounds for invoking a waiver. A waiver is required if ARARs cannot be achieved. Other federal and state advisories, criteria, or guidance, as appropriate (to be considered "TBCs"), should be considered in formulating the remedial action.

ARARs are promulgated, enforceable federal and state environmental or public health requirements. There are two categories of requirements: "applicable" or "relevant and appropriate". CERCLA does not allow a regulation to be considered as both "applicable" and "relevant and appropriate." These categories are defined below:

Applicable Requirements - Section 300.5 of the NCP defines applicable requirements as "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site".

Relevant and Appropriate Requirements - Section 300.5 of the NCP defines relevant and appropriate requirements as "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site."

To be considered (TBCs) are non-promulgated criteria, advisories, and guidance issued by the federal or state governments. Along with ARARs, TBCs may be used to develop interim action limits necessary to protect human health and the environment.

ARARs and TBCs are divided into three categories: chemical-specific, location-specific, and action-specific. This section briefly summarizes the most significant chemical, location and action specific ARARs for the remedy.

a. CHEMICAL-SPECIFIC ARARs

Chemical-specific ARARs are usually health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the determination of numerical values that establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. In general, chemical-specific requirements are set for a single chemical or a closely related group of chemicals. These requirements do not consider the mixture of chemicals. A summary of chemical specific ARARs is presented in Table 1B of Appendix A.

The Safe Drinking Water Act Maximum Contaminant Levels (MCLs) are chemical-specific ARARs that govern the quality of drinking water provided by a public water supply. Because the aquifer at the Site is classified as a potential drinking water source, MCLs are relevant and appropriate requirements in establishing interim ground water levels. In addition, if New Hampshire Drinking Water Quality Standards or New Hampshire Groundwater Protection Standards include a more stringent standard for a site contaminant than the federal MCL, it would become the interim cleanup level for groundwater. As explained above, interim cleanup levels remain in place for the duration of the cleanup. Once the cleanup is complete, final groundwater cleanup levels will be established.

b. LOCATION-SPECIFIC ARARs

Location-specific ARARs are restrictions placed on the concentrations of hazardous substances, or the conduct of activities solely because they are in specific areas. The general types of location-specific ARARs that may be applied to the Dover Municipal Landfill Site are briefly described below and are presented in Table 1C of Appendix A.

Several federal and state ARARs regulate activities that may be conducted in wetlands. These regulations and requirements are applicable to the cleanup because wetlands surround the Site to the west, south and east. The Wetlands Executive Order (E.O. 11990) incorporated into 40 CFR Part 6, Appendix A, require that wetlands be protected and preserved, and that adverse impacts be minimized. In accordance with this Order, EPA specifically solicited public comments on the expected adverse impacts to area wetlands and the proposed mitigation measures. After considering those comments, EPA has determined that no practicable alternative exists that would not disturb the area wetlands since contamination has migrated there and that the selected remedy provides the least amount of disruption to the wetlands. Measures to mitigate impacts include the use of silt fences and hay bales during construction activities and discharge of treated water back into wetlands to maintain water levels. Disturbed wetlands will be restored. Section 404 of the Clean Water Act and State wetland protection regulations are also applicable requirements which restrict activities that adversely affect wetlands and waterways.

Additional location-specific ARARs include the Fish and Wildlife Coordination Act, which requires that any federal agency proposing to modify a wetland or body of water must consult with the U.S. Fish and Wildlife Service.

c. ACTION-SPECIFIC ARARs

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are generally focused on actions taken to remediate, handle, treat, transport, or dispose of hazardous wastes. These action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be implemented. The general types of action-specific ARARs that may be applied to the Site are briefly described below and are presented in Table 1A of Appendix A.

Because the Site contains hazardous waste, RCRA Hazardous Waste regulations apply to certain actions taken onsite. The base RCRA program has been delegated to New Hampshire; therefore, the state and any more stringent federal hazardous regulations governing such activities as waste identification, generator and owner/operator standards, landfill closure, groundwater monitoring, air emissions from process vents, equipment, tanks, and containers apply to the Site.

In particular, the selected remedy must meet the clean closure requirements of RCRA. This means that at the completion of the air-sparging treatment, contaminants remaining in the landfill will not leach concentrations into the groundwater (including groundwater beneath the landfill) that pose a risk to human health or the environment. An appropriate cap must then be placed on the landfill. Should the capping contingency be implemented, hazardous waste landfill closure regulations will apply to the site. During remediation, State groundwater regulations require that a groundwater management zone be delineated and remain in place until cleanup levels are attained.

The New Hampshire Department of Environmental Services has classified the Cocheco River as a Class B river and the Bellamy Reservoir as a Class A, drinking water reservoir. While cleaning up surface water is not a remedial action objective, the New Hampshire Surface Water Quality Criteria (SWQC), although not identified as chemical specific cleanup standards, will be relevant and appropriate when measuring the performance and effectiveness of the air-sparging trench as well as other activities affecting surface waters.

Additionally, other guidelines that need to be considered when conducting the selected remedy are set out in EPA's Monitored Natural Attenuation guidance and Indoor Air Vapor guidance.

3. THE SELECTED REMEDIAL ACTION IS COST-EFFECTIVE

The selected remedy is cost-effective since it provides overall effectiveness proportional to its cost. The selected remedy, the Mixed Alternative, which is estimated to cost $19.4 million, as compared to the original, 1991 ROD at $34.6 million, will treat or remove contamination from the ground water as effectively, if not more so, than the 1991 ROD. The selected remedy will further ensure that the Bellamy Reservoir is protected and will restore ground water more quickly than estimated in the 1991 ROD.

4. THE SELECTED REMEDY DOES UTILIZE PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected remedy provides a permanent solution and alternative treatment and resource recovery technologies to the maximum extent practicable for the ground water plume and Source Control component. Protection is also provided through institutional controls and long-term monitoring. Extrapolations of ground water monitoring data indicate that the Eastern Plume will continue to reduce in size and concentration toward drinking water quality after the Source Control component has been implemented. Interpretation existing data indicates that the aquifer in the Southern Plume will be prevented from discharging into the Bellamy Reservoir and will achieve drinking water standards for many of the contaminants except arsenic in about twenty years. However, arsenic concentrations will need to be monitored carefully over this period.

5. THE SELECTED REMEDY SATISFIES THE PREFERENCE FOR TREATMENT AS A PRINCIPLE ELEMENT

The selected remedy treats contaminated ground water flowing from the landfill into the surrounding aquifers to concentrations protective of human health and the environment. Contaminated ground water in the Southern Plume will be pumped-and-treated to restore the aquifer to drinking water standards. Contaminated ground water in the Eastern Plume will be restored by monitored natural attenuation to drinking water standards. If, after five years, EPA determines that MNA has failed in the Eastern Plume, an active ground water remedy will be employed to restore this portion of the aquifer.

6. FIVE YEAR REVIEWS

Because this Amended ROD will result in contaminants remaining on-site until clean closure is achieved and the aquifer restored, EPA will review the Site at least once every five years after construction is complete at the Site to assure that the remedial action continues to be protective of human health and the environment.

M. DOCUMENTATION OF NO SIGNIFICANT CHANGES

The Proposed Plan to Amend the 1991 ROD was released for public comment in June 2004. The proposed change called for attaining protectiveness of human health through institutional controls, long-term monitoring, construction of an air-sparging trench (with a contingency for capping), and restoration of ground water through both monitored natural attenuation and pump-and-treat. The Amended Proposed Plan also included excavating contaminated sediment from, and then covering, the existing landfill drainage trenches. It also requires an environmental monitoring program, a contingency remedy of pump-and-treat for the Eastern Plume, and five-year reviews.

EPA has determined that, based on comments received during the public comment period which concluded on August 11, 2004, no significant change is needed to the Amended Proposed Plan. EPA has prepared a Responsiveness Summary to address the comments received during the public comment period. The Responsiveness Summary is attached as Appendix D.

N. STATE ROLE

The New Hampshire Department of Environmental Services has reviewed the proposed remedy change for the Site and concurs with the selected remedy described in Section K of this Amended ROD. A copy of the State concurrence letter is attached as Appendix C.

O. REFERENCES

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Golder Associates, December 1996. Dover Landfill Final (100%) Design Report.

GeoInsight, November 15, 2002. Summary of Summer 2002 EMP Event, Dover Municipal Landfill.

USEPA, March 16, 1998. Risk-Based Clean Closure memorandum from Elizabeth Cotsworth, Acting Director, Office of Solid Waste.

USEPA, Environmental Monitoring Systems Laboratory, Las Vegas, NV., March 1985, Site Analysis Dover Landfill, TS-PIC-85010.

Attachment 1: ARARs as they apply to Site Conditions

The Attached Tables, in Order:

Table 1A: Action-Specific ARARs
Table 1B: Chemical-Specific ARARs
Table 1C: Location-Specific ARARs

Table 1A: Potential Action-Specific ARARs

Requirement	Authority	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
FEDERAL - 40 CFR Part 261 RCRA Standards for identification and listing of hazardous waste	Federal Regulatory Requirement	AR for treatment processes RAR to material in landfill	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions of the federal regulations have been adopted by the State.	Excavated material and material generated by treatment processes will be analyzed by appropriate test methods. If found to be hazardous wastes, then they will be managed in accordance with the substantive requirements of the State hazardous waste regulations.
FEDERAL - 40 CFR Part 262 RCRA Standards Applicable to Generators of Hazardous Wastes	Federal Regulatory Requirement	AR	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions of the federal regulation have been adopted by the State.	If remedial treatment or excavation generates hazardous wastes, then they will be managed in accordance with the substantive requirements of the State hazardous waste regulations.
FEDERAL - 40 CFR Part 264 RCRA Standards for Owners and Operators of Hazardous Waste TSDF Facilities	Federal Regulatory Requirement	RAR for landfill and RAR for treatment processes	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. The relevant and appropriate provisions of 40 CFR Part 264 are incorporated by reference.	The specific portions of the State regulations that are relevant and appropriate to the remedial alternatives for the landfill such as closure and groundwater monitoring requirements and applicable for the treatment processes will be identified in Section 5 tables.
FEDERAL - 40 CFR Part 264 Subpart AA RCRA - Air Emission Standards for Process Vents	Federal Regulatory Requirement	AR	Establishes air emission standards for process vents, closed-vent systems, and control devices at hazardous waste facilities; and apply to distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations that "manage hazardous wastes with organic concentrations of at least 10 ppmv."[1]	If process vents are used in remedial action, air emission controls will be implemented if the applicability threshold is met.
FEDERAL - 40 CFR Part 264 Subpart BB RCRA - Air Emission Standards for Equipment Leaks	Federal Regulatory Requirement	AR	Establishes air emission standards for equipment leaks at hazardous waste facilities where equipment "contains or contacts hazardous wastes with organic concentrations of at least 10 percent by weight."[1]	If equipment covered by this standard is used in the remedial action and handles hazardous substance at concentrations that meet this rule's threshold, then air emission controls will be implemented.
FEDERAL - 40 CFR Part 264 Subpart CC RCRA - Air Emission Standards for Tanks, Surface Impoundments and Containers	Federal Regulatory Requirement	AR	Establishes air emission standards for facilities that treat store or dispose hazardous wastes in tanks, surface impoundments, or containers.[1]	If tanks, containers, or surface impoundments are used in the remedial action and meet the applicability threshold, then air emission controls will be implemented

~~1.~~[1]Because New Hampshire has not yet adopted regulations incorporating 40 CFR 264, subparts AA - CC, the Federal regulations are the source for these ARARs.

Table 1A: Potential Action-Specific ARARs

Requirement	Authority	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
STATE - Env-Wm 403.6 Identification and Listing of Hazardous Wastes; Toxicity Characteristic	State Regulatory Requirement	AR	These requirements list particular hazardous waste and identify the maximum concentrations of contaminants for which the waste would be a RCRA characteristic waste because of its toxicity. The analytical test set out in Appendix II of 40 CFR Part 261 is referred to as the Toxicity Characteristic Leaching Procedure (TCLP).	Excavated materials from the Site and material generated by treatment processes will be analyzed to determine whether they are listed or characteristic hazardous waste under RCRA. Materials that are listed waste or exceed TCLP hazardous waste thresholds will be disposed off-site in a RCRA Subtitle C TSDF. Non-hazardous materials will be used as backfill or disposed appropriately.
STATE - Env-Wm 500 Requirements for Hazardous Waste Generators [formerly He-P Ch. 1905.06]	State Regulatory Requirement	AR	Requires determination as to whether waste materials are hazardous and, if so, requirements for managing such materials on site prior to shipment off site.	If remedial treatment or excavation generates hazardous waste that must be shipped off-site, then it will be managed on-site in accordance with the substantive provisions of these regulations prior to off-site shipment.
STATE - Env-Wm 700 Requirements for Owners and Operators of Hazardous Waste Facilities /Hazardous Waste Transfer Facilities [formerly He-P Ch. 1905.08]	State Regulatory Requirement	RAR	Establishes requirements for owners or operators of hazardous waste sites or treatment facilities (federal requirements 40 CFR Parts 264 are incorporated by reference).	The specific portions of these regulations that are relevant to the remedial alternative(s) will be identified and addressed in Section 5 tables.
STATE - Env-Wm 702.10 – 702.13 Groundwater Monitoring [formerly He-P Ch. 1905.08(d)(6)a,b]	State Regulatory Requirement	RAR	Establishes requirements for installation and operation of ground water monitoring network capable of detecting potential migration of hazardous waste or constituents and requires corrective action when necessary. Relevant and appropriate for COCs in ground water.	Remedial alternatives will include ground water monitoring systems that meet the substantive elements of this relevant and appropriate requirement and detect and correct contaminant groundwater releases.
STATE - Env-Wm 708.02(a)(12) Closure and Post-Closure Disposal Units	State Regulatory Requirement	RAR	Incorporates by reference 40 CFR 264.110 - .120 (subpart G). Landfill must be closed in a manner that controls, minimizes or eliminates the potential for land filled COCs to threaten human health and the environment. Closure design must also minimize maintenance of the Site. After the Landfill is closed and waste is left in place, regular monitoring and maintenance must be performed for at least 30 years.	Source control remedy will comply with the substantive requirements of these regulations for landfills with waste left in place or for clean closure.
STATE - Env-Wm 708.03 (d)(1) Use and Management of Containers	State Regulatory Requirement	AR	Establishes requirements for the condition of containers, compatibility of hazardous waste stored in containers, and the management, inspection, and closure of containers. Incorporates by reference 40 CFR 264.170-.179 (Subpart I).	If excavated materials or any other materials generated from the remedy are hazardous waste and are managed in containers, then the containers will be managed to meet the substantive portion of this requirement.

Table 1A: Potential Action-Specific ARARs

Requirement	Authority	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
STATE - Env-Wm 708.03(d)(2) Tanks	State Regulatory Requirement	AR	Tanks or tank systems used to temporarily store hazardous liquids or as part of a treatment system for hazardous liquids or sludges must be designed, installed and operated in accordance with the RCRA Standards. Incorporates by reference 40 CFR 264.140 - .198 (subpart J).	If a tank or tank system is used for storing or treating hazardous wastes as part of Site remediation, it must be constructed with secondary containment and a leak detection system, and comply with monitoring and inspection requirements.
STATE – Env-Wm 708.03(d)(4) Waste Piles [formerly He-P Ch. 1905.08(f)(l)(d)]	State Regulatory Requirement	AR	General design and operation requirements for temporary storage of hazardous soils and/or sludges. Locations must have an impermeable liner and materials stored in piles must be free of standing liquid. Incorporates by reference 264.250-259 (subpart L).	If hazardous waste piles are included in the remedial alternative selected for the Landfill, then these requirements must be met.
STATE - Env-Wm 1403 Ground Water Management and Ground Water Release Detection Permits	State Regulatory Requirement	AR	Prohibits discharge of hazardous waste to ground water, or any discharge of ground water that would result in a violation of surface water quality in adjacent surface waters. Also, ground water cannot be altered so as to make it unsuitable for drinking. Establishes groundwater management zones (GMZ).	Ground water monitoring and treatment will be required to attain State AGQSs. Any ground water discharges from treatment systems, including the treatment trench, must meet the applicable standards. A GMZ will be established at the site and will remain in place until cleanup goals have been attained throughout the GMZ.
STATE – RSA 485-A:17 and NH Admin. Code Env-Ws 415 Terrain Alteration	State Regulatory Requirement	AR	Establishes criteria to control erosion and run-off for any activity that significantly alters the terrain.	Any action taken at the Site that will disturb an area of more than 100,000 contiguous square feet must comply with these criteria.
STATE – NH Admin. Code Env-A Part 1002 Fugitive Dust Control	State Regulatory Requirement	AR	Requires precautions to prevent, abate and control fugitive dust during specified activities, including excavation, construction and bulk hauling.	Precautions to control fugitive dust emissions will be required both during and after Site remediation.
STATE - Env-Ws 1500 New Hampshire Ground Water Discharge Permit and Registration Rules	State Regulatory Requirement	AR	These regulations established substantive requirements for discharges to ground water, including prohibited discharges (Env-Ws 1503.04), compliance criteria (Env-Ws 1504.03), water quality sampling (Env-Ws 1507.01).	If water is discharged into the Landfill, into the surrounding area, or to ground water, then such discharges will receive appropriate treatment to comply with the substantive requirements of this ARAR.

Table 1A: Potential Action-Specific ARARs

Requirement	Authority	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
STATE - Env-A300 Ambient Air Quality Standards	State Regulatory Requirement	AR	Establishes primary and secondary level for eight air contaminants: • particulate matter • sulfur dioxide • carbon dioxide • nitrogen dioxide • ozone • hydrocarbons • fluorides • lead Seven of the primary and secondary standards established under this State standard are adopted from the federal NAAQS.	These air contaminant levels will be used to establish target levels for air releases from the Site and site remediation activities.
STATE - Env-A 1300 Toxic Air Pollutants	State Regulatory Requirement	AR	Establishes ambient air limits for 74 chemicals. These ambient air limits (AALs) are levels at, or below, which ambient air concentrations of respective air contaminant will not adversely affect human health.	Releases of contaminants to the air from any source on Site will not exceed applicable AALs. Air emission controls will be implemented if needed to prevent any detected exceedences.
STATE - Env-Ws 904 Pretreatment Standards	State Regulatory Requirement	AR	Provides standards for indirect discharge of pollutants to POTWs.	SC-7A will comply with the substantive requirements of this regulation. If levels of contaminant concentrations in groundwater to be discharged to the POTW interfere with the performance of the system, or would cause the POTW to violate water quality standards, or adversely impacts the sludge produced, the groundwater shall be pretreated either on site or at the POTW before entering the system.
STATE – Chapter We 600 Standards for construction, maintenance and abandonment of wells	State Regulatory Requirement	AR	These regulations apply to the construction, maintenance and abandonment of wells.	Wells will be constructed, maintained, relocated and/ or abandoned according to these regulations.
FEDERAL - OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils, 67 Federal Register 71169 (Nov. 29, 2002), http;//www.epa.gov/correctiveation/cis/vapor.htm	Federal guidance	TBC	This draft guidance establishes a methodology for assessing indoor air risks to human health.	Potential risks associated with indoor air at residences near the Site will be evaluated and monitored consistent with this guidance.
FEDERAL – EPA Guidance: Risk-Based Clean Closure, March 16, 1998	Federal Guidance	TBC	This guidance describes risk-based clean closure at RCRA hazardous waste units.	Remedial alternatives involving clean closure will be closed consistent with this guidance.

Table 1A: Potential Action-Specific ARARs

Requirement	Authority	Status	Requirement Synopsis	Action to be Taken to Attain Requirement
FEDERAL – Technical Guidance for Final Covers on Hazardous Waste Landfills and Surface Impoundments: EPA/530-SW-047; July, 1989	Federal Guidance	TBC	This guidance sets out criteria for hazardous waste landfill covers	Remedial alternatives involving RCRA C caps will be implemented consistent with this guidance.
FEDERAL– Technical Memorandum – EPA Region 1 from Dennis Gagne and Yoon-Jean Choi to Office of Site Remediation and Restoration (February 5, 2001) http://www.epa.gov/region1/superfund/resource/C524.pdf	Federal Guidance	TBC	This guidance sets out criteria for alternative hazardous waste landfill covers.	Remedial alternatives involving RCRA C caps may consider this guidance.
FEDERAL – Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. OSWER Directive 9200.4-17P, April 21, 1999.	Federal Guidance	TBC	This guidance sets criteria for evaluating monitored natural attenuation as a remedy at, among others, Superfund sites.	Remedial alternatives that incorporate monitored natural attenuation for groundwater will demonstrate the effectiveness of this alternative for addressing groundwater in an acceptable amount of time consistent with this guidance.
State – Surface Water Quality Standards, Env-Ws 1708	State Regulatory Requirement	Relevant and Appropriate	Standards for protection against degradation of surface water (check this). Standards and criteria based on federal ambient water quality criteria for protection of human health and aquatic life.	Standards will be used to measure the performance and effectiveness of remedial alternatives in preventing contaminated groundwater and surface runoff and discharges from degrading nearby surface waters.
Federal – CWA Section 402, National Pollutant Discharge Elimination System (NPDES)	Federal Regulatory Requirement	AR	Contains discharge limitations, monitoring requirements, and best management practices. Substantive requirements under NPDES are written such that state and federal ambient water quality criteria (AWQC) are met.	On-site discharges shall meet the substantive discharge standards.